Natural Sciences and Engineering Research Council of Canada
Conseil de recherches en sciences naturelles et en génie du Canada

REPORT OF

THE TASK FORCE ON RESEARCH INFRASTRUCTURE

TO THE

NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL

OTTAWA

AUGUST 1984

(Aussi Disponible en français)

Canada

Table of Contents

		Page
Executive Summary		iii
Chapter 1	Introduction	1
Chapter 2	The Method of Approach	5
Chapter 3	Results from the Questionnaire and Visits	12
Chapter 4	Examination of the Existing Infrastructure Grants Program	27
Chapter 5	Centralization vs Decentralization of Technical Services	31
Chapter 6	Future Trends in University Funding	36
Chapter 7	What is Required	40
Chapter 8	Mechanisms for Implementation of an Expanded Infrastructure Program	44
Chapter 9	Funding Implication of Task Force's Proposals	51
Bibliography		57

Appendices

A	Membership of the Task Force on Research Infrastructure	58
B	List of Nineteen Institutions Surveyed by Questionnaire	59
C	Questionnaire Completed by University Departments	60
D	Questionnaire Completed by Central Service Facilities	71
E	Letter Sent to the Nineteen Universities Selected to Complete the Questionnaires	81
F	Letter Sent to the Universities Which Were Not Sampled by Means of Questionnaires	83

Table of Contents (Cont'd)

Appendices		Page
G	List of Universities Visited by Task Force Members	84
H	Program Description - Infrastructure Grants	85
I	Nature of Infrastructure Type II Facilities Supported and Distribution of Infrastrucutre Support by Discipline Committee	90
J	Discussion Paper Outlining Some Options for an Expanded Role for NSERC in the Support of Research Infrastructure	92
K	Minority Report by Alain Caillé	96

NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL
TASK FORCE ON RESEARCH INFRASTRUCTURE

EXECUTIVE SUMMARY

The Task Force on Research Infrastructure was established by the Executive Committee of Council in December, 1983, to (1) review the present state of the infrastructure for research in the natural sciences and engineering in Canadian universities, excluding faculty manpower resources, (2) examine the effectiveness of the existing NSERC Infrastructure Grants Program, (3) examine the relative effectiveness of centrally-operated and centrally-funded technical services, (4) examine the current division of responsibility for research infrastructure support between the two levels of government and comment on future trends, and (5) make recommendations on an appropriate future role for NSERC in the support of research infrastructure in the universities.

Definition of Research Infrastructure Costs

For the purpose of this study, research infrastructure costs were defined as the costs associated with the maintenance and operation of specialized equipment and the provision of technical support services which are **used in common** by a number of faculty researchers and their associates.

Methodology

The Task Force used questionnaires, supplemented by visits of the members and NSERC staff, to obtain information on the present state of research infrastructure in the universities. One version of the questionnaire was completed by science and engineering departments in nineteen universities, representing some 66 percent of NSERC grants for 1983-84, and selected on the basis of size, level of research activity, geographic region and language.

This questionnaire sought information on (1) the general profile of the reporting unit, (2) the number and cost of existing infrastructure personnel and sources of salary funding, (3) additional infrastructure personnel needed, (4) recent trends in the level of infrastructure personnel support, and (5) current non-salary infrastructure funding and additional non-salary needs.

An appropriately modified version of the departmental questionnaire was completed for central services, e.g., computer centre, animal quarters, shops, etc., in each of the nineteen universities.

Members of the Task Force also consulted grant selection committees, other committees of Council and Council itself. In addition, meetings were held with the chairmen of three provincial advisory committees on university affairs.

Profile of Researchers

The results of the questionnaires revealed that each professor actively engaged in research has on average 2.2 graduate students, 0.4 postdoctoral fellows or research associates and 0.8 technicians (including research technicians in central services). Using a weight of one-half to convert research faculty and graduate students to full-time equivalent (FTE) researchers, it was found that the technician to FTE researcher ratio in the universities in the natural sciences and engineering is 0.4. This is to be compared with 0.8 at the National Research Council of Canada and 1.1 for three representative industrial research laboratories.

Additional Research Infrastructure Needs

The responses to the questionnaires, extrapolated to the total university system, are summarized in the following table:

Additional Infrastructure Needs	Number of Personnel	Cost $ M	% Increase in Cost Over Present
1. Personnel - science and engineering departments	1023	28.6	72
2. Non-salary - science and engineering departments	-	12.6	74
3. Personnel - central services	165	4.6	29
4. Non-salary - central services	-	2.1	16
5. Total additional needs	1188	47.9	56

An average salary and benefits figure of $28,000 was used to calculate the costs of personnel, which includes PhDs and professional engineers in addition to technicians and research assistants.

It is the Task Force's firm view that the additional needs identified by means of the questionnaires are not overstated and are probably on the conservative side. No allowance has been made for growth in the overall level of research activity in the universities, for development of new programs in emerging areas of scientific and technological opportunity, or for rapid changes in scientific instrumentation.

The Task Force has concluded that there is an urgent need for further infrastructure support of some $48 M for NSERC-sponsored research. It is convinced that our best university researchers would be far more productive and, therefore, much more competitive internationally, if they had the skilled technical manpower needed to ensure maximum use of sophisticated equipment which is kept up-to-date and in a good state of repair. The Task Force believes that the quality of graduate education would be greatly enhanced if highly skilled technical personnel were available to assist in training and supervising students in the use of the equipment and in the execution of complex laboratory procedures. It is also firmly of the view that the university research

enterprise would be strengthened if Canada's major research-oriented universities were in a position to maintain the kind of services related to computation, electronics and instrumentation that one finds in leading government and industrial research laboratories.

Regional and Disciplinary Variations in Research Infrastructure

The ratios of technical support staff per million dollars of sponsored research funding are fairly uniform from region to region with the exception of Ontario where this ratio, in relation to NSERC projects and programs, is only one-half that of the rest of the country. Furthermore, the proportion of research infrastructure staff funded by the university, as distinct from external research grants, is lower in Ontario than in any other region.

With respect to infrastructure support by discipline, the most striking observation is the wide variation in the ratio of university-funded to NSERC-funded staff associated with NSERC projects and programs: 7.7 for Chemistry, approximately 3 for Biology, Earth Sciences and Engineering, 1.2 for Physics and 0.2 for Mathematics and Computer Science.

Examination of NSERC's Present Infrastructure Grants Program

The present infrastructure grants program includes the support of specialized research facilities, such as large or special items of equipment, as well as the support of highly skilled technical or professional research support staff who perform functions essential to the maintenance of the research activities of a number of faculty researchers. However, the present program encompasses only a fraction of the total research infrastructure requirements in universities. The 1984-85 Awards Guide explicitly states that Infrastructure Grants "are not intended to assist in the maintenance of facilities standard in a discipline and present in many university departments". Yet, there is considerable evidence that many expensive facilities, which are now standard in a discipline, are not being provided with the maintenance and technical services needed to ensure efficient use.

While there has been a significant increase in infrastructure support by NSERC in recent years (from $7.9 M in 1982-83 to $12.7 M in 1984-85), the Task Force found clear evidence that the present program is not only seriously inadequate in levels of funding but is too restrictive in the categories of expenditure eligible for support.

Centralization vs Decentralization of Technical Services

As might be expected, the extent of centralization at the university level is related to the size of the institution. A single machine shop or electronic shop might be appropriate for a small university but would be less effective in providing specialized services to researchers in large institutions than shops under departmental supervision.

While the Task Force found no tendency towards further centralization at the university level, the same is not true at the departmental level where, to an increasing extent, technical support services and experimental facilities are being brought together to increase efficiency. While in many universities such departmental facilities are still supported from university budgets, user fees or levies against research grants are covering an increasing share of their operating costs. Full cost recovery has become not uncommon.

It is the view of the Task Force that NSERC funding policies should encourage the formation of central services at the departmental level. This will require a change in the regulations requiring the itemization against individual grants of expenditures and the prohibition against pooling grant funds.

Future Trends in University Funding

There is unanimity among senior administrators that universities will have increasing difficulty supporting the infrastructure costs of research. This pessimistic view of the future was shared by the provincial grants committee chairmen whom the Task Force consulted. It follows that if NSERC is to ensure that an effective infrastructure base exists in the universities for the research that it supports in its grants-in-aid programs, it must assume an increasing share of the infrastructure costs. In this context, however, it should be noted that certain provinces, especially the Province of Quebec, are beginning to support in a significant way both basic and applied research in their universities and by so doing have given specific recognition to the infrastructure costs associated with this research.

Mechanisms for Implementation of an Expanded Infrastructure Program

Since the present program of providing infrastructure support for **major facilities of a specialized nature** based on peer evaluation of the excellence of the research program associated with the facility and of need appears to be functioning very satisfactorily, the Task Force has concluded that it should continue. Included in this category are nuclear installations, field stations, marine facilities, regional facilities, major inter-departmental and inter-university research centres or institutes. In the most recent competition, funding for these amount to approximately $7.6 M per year.

A number of approaches were considered by the Task Force for the apportionment of infrastructure funds in support of facilities and services which do **not** belong in the category of major facilities of a specialized nature. This second category includes certain facilities that are funded under the present infrastructure program, as well as some which are currently ineligible. It was concluded that the most satisfactory mechanism would be one involving block grants calculated on the basis of a formula relating to the total of NSERC grants that generate a research infrastructure requirement.

It is proposed that one half of the total block grants be awarded directly to departments in relation to their NSERC funding and that one half be allocated at the university level. Providing infrastructure support to departments would deliver funding closer to the level of the research performer and, therefore, achieve a close correlation with excellence. Futhermore, decisions on the use of such funds would be made at the grassroots level and should be most in tune with real needs. On the other hand, by providing universities with a substantial allocation, they would be in a position to provide better support for centralized facilities, to correct inequities in the departmental allocation in relation to need, to encourage the formation of high-quality interdepartmental facilities and services, and to support new initiatives that require infrastructure funding.

While no mechanism of allocation can fully respond to all infrastructure problems, the Task Force believes that, on balance, a formula allocation that is directed at both the departmental and university levels would be the most flexible and effective.

Based on the existing levels of NSERC-sponsored research activity, it is concluded that $52 M per annum should be directed to this new block grant infrastructure program. This amount comprises $48 M of new funding, the need for which has been documented in this Report, and $4 M transferred from the present Infrastructure Program.

RECOMMENDATIONS

The recommendations of the Task Force are given below with page cross-referencing to the body of the report.

		Cross-Reference Page
1.	NSERC funding policies should encourage the formation of central services at the departmental level. This will require a change in the regulation (para. 203 of the 1984-85 Awards Guide) requiring the itemization of expenditures against individual grants and prohibiting the pooling of grant funds. Pooling of up to 10% of NSERC grant funds on a voluntary basis should be permitted. Such pooled resources could only be used in support of the direct costs of research and would be administered in accordance with NSERC regulations. As well, NSERC should consider supporting seminars and/or workshops on how to centralize these services effectively. Case studies of several successful operations could be used for this purpose.	35
2.	It is recommended that increased funding of $48 M per annum be allocated to support personnel and non-salary infrastructure needs identified in this report.	43
3.	Infrastructure grants in support of major facilities of a specialized nature should be made on the basis of applications and peer review. Existing procedures appear to be adequate and should be continued.	49
4.	Other NSERC infrastructure support, including the support of facilities and services that are standard in a discipline, should be made in the form of block grants, with 50% of the funding being allocated to the university and 50% to departments.	49
5.	Departmental infrastructure block grants should be based on the total individual and team operating grants, strategic grants, PRAI grants and other project grants as well as a six-year average of regular equipment, major equipment and strategic equipment grants received by department members; university infrastructure block grants should be determined by the total amount of the above-named grants for the whole university.	49

6. Council should establish clear guidelines for eligible categories of expenditures and allocation procedures for infrastructure block grants and should require annual reports from each unit receiving such grants. 50

7. Based on current levels of NSERC-sponsored research activity, $7.6 M per year should be allocated to infrastructure grants in support of major facilities of a specialized nature and $51.9 M per year to infrastructure block grants to departments and universities. Included in the latter is new funding of $48 M per year, the need for which has been documented in this report. 55

Chapter I

INTRODUCTION

The past five years have witnessed a major increase in the level of sponsored research funding in Canadian universities, especially in the disciplines supported by the Natural Sciences and Engineering Research Council. During the same period, however, university operating budgets have declined in real terms. Yet, it is this core funding, derived primarily from provincial grants and tuition fees, that provides universities with the means to sustain the faculty manpower resources and basic infrastructure upon which externally-sponsored research programs ultimately depend.

Recent data, compiled by Statistics Canada, on the level of university R&D funding from various sources for the natural sciences, including the health sciences and engineering, is shown in Table I. Whereas total sponsored research funding, of which approximately 55 percent is provided by NSERC, has increased by 22 percent in real terms from 1979 to 1984, the university contribution has declined by some 5 percent.

TABLE I

Source of Funds for University Research and Development in Natural Sciences and Engineering

	Sponsored Research Funding					
	Fed. Depts and Agencies	Prov. Depts and Agencies	Other	Total	Univ. Expend. from Oper. Budgets *	Total R&D Support
1979 ($M, current)	211	60	53	324	329	653
1984 ($M, current)	396	126	76	598	472	1070
% increase (current $)	87.6	110.0	43.4	84.6	43.5	63.9
% increase (constant $)	24.2	39.2	-5.1	22.2	-5.1	8.5

* The method employed by Statistics Canada to estimate R&D expenditures from university operating budgets involves a number of subjective assumptions concerning the allocation of faculty salaries and other costs between teaching and research. While the actual dollar amounts shown are open to some question, trends over a number of years are significant. (Sources: Statistics Canada, R&D Expenditures in Canada, May 1983 and 1984 update)

These data reinforce the concerns expressed to NSERC by the members of its research community that, as provincial funding of universities has declined in real terms and both undergraduate and graduate student enrolments in the natural sciences and engineering disciplines have increased, more of the costs traditionally funded from university operating budgets are being charged against the research grants of faculty. This is particularly the case in such areas as equipment repair and maintenance. As a consequence, these grants, although substantially larger than in the 1970's, are becoming increasingly inadequate to sustain an appropriate level of research and research manpower training.

Council addressed this growing problem initially in 1982-83, by expanding the core grants program, now called the infrastructure grants program. Previously, core grants were restricted to major research facilities such as marine facilities, telescopes and nuclear accelerator installations. The present infrastructure grants program covers a broader range of facilities (they are no longer required to be "unique"), with provision for the support of highly skilled technical or professional research support staff who perform particular functions essential to the maintenance of the research activities of a group. As a consequence of this broadening of the eligibility requirements, technical support services which are not necessarily associated with a major equipment facility can now be supported under the program. Nevertheless, the present program encompasses only a fraction of the total research infrastructure in universities because it is still restricted to "major research resources which would not normally be available in Canadian universities and for which it would be unreasonable to expect adequate support from users' fees, operating grants and/or other sources".

NSERC's Awards Guide explicitly states that infrastructure grants "are not intended to assist in the maintenance of facilities standard in a discipline and present in many university departments". Therein, however, lies the difficulty since there have been numerous reports that expensive facilities such as electron microscopes, X-ray crystallographic equipment, mass spectrometers, computer-aided design facilities and the like, which are standard in a discipline, are not getting the maintenance and technical services needed to ensure efficiency. To the extent that this problem now exists, it can become only more acute in the future as facilities standard in a discipline become increasingly sophisticated and new research methodologies require highly skilled and specialized technical support staff.

It is worth noting that in 1981, the NSERC Task Force on Research Equipment recommended to Council that the grant selection committees be provided with an allocation for the maintenance and operation of existing major equipment, and that a new program of core grants be established for the infrastructure support of new major equipment purchases. The Task Force also recommended that all applications for equipment (i.e., anything over $7000) be accompanied by a three-year maintenance grant. Council, however, at the time was not prepared to establish such a broadly-based program of infrastructure support.

Funding Levels of the Present Infrastructure Program

Infrastructure grant applications under the present program usually fit into one of two categories. Applications relating to only one discipline and requesting funding of less than $100,000 (Infrastructure I applications) are normally reviewed by the appropriate grant selection committee and funded in part from the committee's budget. Large applications (other than those for the support of nuclear accelerators and telescopes), applications of a multidisciplinary nature, and applications associated with requests for major equipment or major installations (Infrastructure II applications) are reviewed and funded by the Committee on Grants and Scholarships.

Total funding under this program in each of the last two years is as follows:

Year	Infrastructure Type I*	Infrastructure Type II	Total
1983-84	$7.0 M	$3.2 M	$10.2 M
1984-85	$8.7 M	$4.0 M	$12.7 M

*Includes $4.2 M in 1983-84 and $4.0 M in 1984-85 for nuclear accelerators.

The Future

If Council were to expand its program of infrastructure grants beyond the support of specialized research resources to include "the maintenance of facilities standard in a discipline and present in many university departments", it would be assuming costs that have been borne to date primarily by the universities. There is mounting evidence, however, that a serious obstacle to the further strengthening of the role of universities in research, including research related to the needs of industry, is the inability of universities to fund, from their own budgets, the increased level of technical services needed to support their research activities. As increased demands are placed on the universities for research related to the strategic needs of our country, this problem will become even more acute. It was in recognition of this fact that Council, in its Brief to the Royal Commission on the Economic Union and Development Prospects for Canada, made the following assertion:

> "The Government of Canada has assumed the responsibility for the overall vitality of university research. It, therefore, must ensure that the basic infrastructure for that research, and the manpower training capabilities based on it, remain intact and are strengthened."

The issue of university research infrastructure needs and the appropriate role of NSERC in responding to these needs is of special importance at this time when Council is establishing funding priorities for its second Five-Year Plan. Consequently, the Executive Committee of Council, at its meeting on December 8, 1983, established the Task Force on Research Infrastructure to examine the issue in some depth and to make recommendations to Council by July 31, 1984.

Subsequently, the following Terms of Reference were developed and approved by Council.

1. To review the present state of the infrastructure for research in the natural sciences and engineering in Canadian universities, **including** specifically the maintenance and operation of equipment and the provision of technical services, but **excluding** faculty manpower resources.

2. To examine the effectiveness of the existing NSERC infrastructure grants program and of the mechanisms and procedures for its operation, including consistency of interpretation.

3. To examine the relative effectiveness and economy of centrally-operated and centrally-funded equipment maintenance and technical services as distinct from other patterns of operation.

4. To examine the current situation and comment on future trends in the division of responsibility for the support of research infrastructure between the provinces and the federal government.

5. In light of the foregoing, to make recommendations on an appropriate future role for NSERC in the support of research infrastructure, to estimate the required level of funding and to propose mechanisms and procedures for its implementation.

The membership of the Task Force is listed in Appendix A of this report.

Chapter 2

THE METHOD OF APPROACH

Definitions

The first undertaking of the Task Force was to establish a definition of infrastructure costs which would be consistent with NSERC's present policy of funding only the **direct** costs of research and would assure complementarity with Council's existing grant programs. Accordingly, the assumption was made that the costs of manpower and services which are specific to an individual faculty researcher should normally be funded from the operating or strategic grants held by that researcher. Infrastructure costs were defined as the costs associated with the maintenance and operation of specialized equipment and the provision of technical support services which are **used in common** by a number of faculty researchers and their associates.

In developing this definition, the Task Force recognized that it was being somewhat restrictive, especially in relation to small universities and certain subdisciplines where there may be an individual faculty researcher requiring a particular facility or service which would be used in common by a number of research groups in a larger institution. Nevertheless, the Task Force concluded that it would be inappropriate to define infrastructure costs so broadly that they would embrace, for example, personal technicians. While the special problem of the individual faculty researcher requiring an infrastructure type service might be most effectively addressed by awarding operating grants which better reflect the varied costs of research, the Task Force appreciated that any expanded infrastructure program must be sufficiently flexible to accommodate special situations.

The Task Force also decided, **for the purpose of this study**, to exclude from the definition of infrastructure, library resources and services. This is not to say that these are not of fundamental importance to all university research, in the natural sciences and engineering or in other disciplines, nor that universities are not having severe difficulties in maintaining adequate journal collections and in meeting rapidly growing needs for information services. Nevertheless, the Task Force concluded that the library issue is of such major proportions that it can best be addressed in the context of the broader question of the appropriate sharing of postsecondary education costs between the two levels of government.

The Task Force decided early in its deliberations that the most effective way of obtaining quantitative information on the present state of research infrastructure was by means of a questionnaire. Because definitions played such an important role in the investigation, the full text of the section relating to this matter, which accompanied the questionnaires to the universities (see next Section), is set out in the following pages.

DEFINITIONS

Research costs can be divided into three categories, each of which is defined below.

Traditional Direct Costs - Costs which would normally be funded by NSERC grants. These include:

- graduate student stipends,
- salaries of research assistants or associates, either technical or professional, whose work is primarily associated with a single grantee,
- materials and supplies including the purchase of living materials for specific projects and the cost of maintenance of living materials after their purchase by researchers,
- capital costs of equipment and major installations,
- machine, electronic, glassblowing, and computer services related to specific projects, (for example, the hourly charge for the construction of a piece of equipment and the charges associated with using a shared computing resource).

Traditional Indirect Costs - Costs associated with the provision of light, heat, water, laboratory space, storeroom services, secretarial support and other administrative services. Also included are the capital and overhead costs associated with the operation of machine shops, animal quarters, greenhouses, etc.

Infrastucture Costs - The Task Force recognizes that the lines of demarcation between direct, indirect and infrastructure costs are blurred. **For the purposes of this questionnaire, infrastructure costs are considered to be the costs associated with (i) the maintenance and operation of specialized research equipment and (ii) the provision of technical support services which are used in common by a number of faculty researchers and their associates.**

For the purpose of this questionnaire only, infrastructure costs DO NOT include (a) the salary and fringe benefit costs for faculty, (b) the salary and fringe benefit costs for support personnel required to maintain a facility for the purpose of undergraduate teaching, and (c) the salary and fringe benefit costs for support staff who are working on the research programs of an individual researcher or a single research group. (These costs would normally be charged to the grants or contracts supporting these programs.)

To provide further clarification of the definition of infrastructure costs used in this questionnaire, such costs have been divided into the following four broad categories.

1. Salary costs associated with equipment

   The salary and fringe benefit costs of personnel dedicated to the operation and maintenance of specialized equipment.

   This category includes highly skilled technicians who operate such items of equipment as electron microscopes, x-ray diffraction units, NMR spectrometers, shared computers for specialized research projects, amino-acid analyzers, etc., regardless of whether this equipment has become relatively standard in certain disciplines. Such apparatus often requires the skills of an experienced operator for maximum efficiency and/or capability and is used in common by a number of faculty researchers.

   Also included are professionals who provide expert management for, and the technical support staff associated with, a major installation or regional facility; for example, the NMR regional facilities at the University of Guelph and Dalhousie University.

2. Salary costs associated with technical services

   The salary and fringe benefit costs of personnel who provide highly skilled technical or professional services not necessarily related to a particular piece of equipment.

   This category includes personnel associated with such activities as materials preparation, software and hardware maintenance of shared research computing facilities, tissue culture services, DNA sequencing, analytical services, general support for field studies, etc. These should be services used in common by several research groups rather than services associated with the program of an individual researcher or a single research group.

3. Salary costs associated with service facilities

   The salary and fringe benefit costs of personnel associated with research service facilities (shops, greenhouses, growth chambers, animal care facilities, etc.).

When such facilities as those listed above are used to support research, incremental costs, which are over and above the costs associated with a basic facility providing support for undergraduate teaching, accrue. **For the purposes of this questionnaire**, only these incremental costs are considered as research infrastructure costs. Included in this category are the costs of research advisory services provided by the facility (for example, advice on the design and construction of complex apparatus). Also included are advisory services on the choice of a computer hardware and/or software configuration and the selection and maintenance of mini-computers and their interfacing with other apparatus.

4. Non-salary costs

The costs of equipment maintenance (service contracts, replacement parts, minor upgrading, etc.).

Examples of the above are the costs of x-ray diffraction targets, laser tubes, standard vendor computer maintenance contracts, replacement parts and minor upgrading of specialized research equipment found in animal care facilities, greenhouses and environmental chambers, etc. These costs are appropriately designated as infrastructure costs **only** when the equipment is used in common to support the research of several research groups. Note: If the equipment is only used to support the research of an individual researcher or a single research group, maintenance costs would normally be charged to the grants or contracts which support the research.

Description of the Questionnaires

A questionnaire was devised and, following pretesting and revision, was sent to natural sciences and engineering departments at the nineteen universities shown in Appendix B. These universities were selected on the basis of size, level of research activity, geographic region and language. (In total, they received approximately 66 percent of the NSERC grants for 1983-84.)

The questionnaire (Appendix C) solicited information under a number of headings:

Section A The general profile of the reporting unit, including the number of faculty, graduate students, technicians and postdoctoral fellows, and the total research funding from NSERC and other sources.

Section B Numbers and costs of existing infrastructure personnel working on NSERC sponsored research and on research sponsored by other agencies and, in each case, the sources of salary funding (NSERC, university and other).

Section C **Additional** infrastructure personnel needed to efficiently carry out the research programs, their salary costs, and the functions they would perform.

Section D Trends in the level of infrastructure personnel support in the unit over the past two years.

Section E Present level of non-salary infrastructure support (equipment replacement parts and minor upgrading, service contracts, etc.) and additional needs.

Section F Infrastructure **type** personnel providing a service for an individual faculty researcher as distinct from a service for a number of research groups (a broadened definition of infrastructure).

In addition to the questionnaire sent to departments, a somewhat different version (Appendix D) was developed for central services, e.g. computer centre, animal quarters, shops, etc., in the universities.

In preparation for the administration of the questionnaires, a letter was sent by the President of NSERC, Mr. G.M. MacNabb, to the Presidents of the nineteen universities (Appendix E) informing them of the Task Force and its mandate and asking for their cooperation. Each President was asked to name a Liaison Officer who was invited to a meeting to discuss the questionnaire, its interpretation and the time constraints of the study. The Liaison Officers were responsible for ensuring that all departments and service units in their respective universities completed the questionnaire, that duplication was avoided and that problems of interpretation were resolved. The accuracy with which the questionnaires were completed was in no small part a result of the work of these individuals.

The Presidents of all other universities were also informed of the work of the Task Force by means of a letter from Mr. MacNabb (Appendix F). They were provided with a copy of each questionnaire and their institutions were given the opportunity to participate in the exercise should they wish to do so. Several universities sent comments and three completed questionnaires.

A total of 351 questionnaires were completed by the nineteen universities identified in Appendix B. From these, the Task Force assembled data on each question according to the size of the institution, the region of the country and the discipline, and performed certain analyses appropriate to the investigation.

Visits to Universities

Early in its deliberations the Task Force decided that site visits would be made by at least one Task Force member, accompanied by a member of NSERC staff, to most of the responding institutions. The purpose of these visits was in part to review in detail questionnaire responses with two or three departments in each university, and to determine whether the definition of infrastructure established by the Task Force was understood and whether the information provided was consistent from department to department and from institution to institution. These visits also provided Task Force members with an opportunity to gain an on-site impression of the present state of infrastructure in the institutions and to determine whether or not the infrastructure needs given by respondents were inflated (i.e. simply a wish list) conservative, or fully justified.

In addition to reviewing the responses to the questionnaires, the Task Force members explored other issues during their visits, including the effectiveness of the current infrastructure program, current and future provincial funding, the effectiveness of centrally-operated and centrally-funded services, and the possible mechanisms and procedures which might be used for distributing "new" infrastructure funding were such to become available.

In general, the site visits followed a pattern that had been agreed to by the Task Force prior to any visits being made. The first call was to the office of the Liaison Officer who had made all of the local arrangements. This was followed by a meeting with the senior administration, usually including the President. Visits were then made to several departments, where discussions were held with the Chairman who was often accompanied by colleagues, to the Computing Centre and/or to other special central service units.

Fifteen of the nineteen universities were visited during the period of May 2 to June 7, 1984. In addition, a special visit was made to Queen's University to see the Statistical Consulting Service Unit and to meet with the Principal. A schedule of the visits is given in Appendix G.

Consultation with Committees of Council

The February operating grants competition provided a unique opportunity for consultation and discussion with NSERC grant selection committees (GSCs) on the effectiveness of the existing NSERC infrastructure grants program (Term of Reference 2), as well as on the infrastructure needs of the various disciplines

and the possible mechanisms for distribution of funds through an expanded infrastructure program. As a follow-up to these meetings, several of the GSCs prepared written presentations which were extremely helpful to the Task Force in its deliberations. In addition, there were consultations with a number of past and present GSC members.

As the work proceeded, the Task Force consulted other Committees of Council, including the committee on Grants and Scholarships, the Manpower Task Force, the newly formed Advisory Committee on Engineering, and Council itself, to gain additional input on the infrastructure question.

Other Consultations

The Task Force decided that it would not seek meetings with officials of the various Ministries of Education. The Chairman, however, did have discussions with the chairmen of three of the provincial advisory committees on university affairs, Dr. Marnie Paikin of the Ontario Council of University Affairs, Mr. John Terry of the Maritime Provinces Higher Education Commission and Dr. William Gibson of the Universities Council of British Columbia. In addition, there was an opportunity to discuss certain aspects of the Task Force's mandate with the Commission de la recherche universitaire, a sub-committee of the Conseil des universités du Québec which has itself recently carried out a study on the impact of federal financing on the development of the university network.

Extremely important to the work of the Task Force were the informal discussions of its members with colleagues at their own universities and elsewhere. Also, the staff of NSERC provided valuable insights.

Chapter 3

RESULTS FROM THE QUESTIONNAIRE AND VISITS

The needs outlined in Table 2 represent the results for the nineteen institutions surveyed. The needs for all of Canada are given in Chapter 7 (Table 12), where the figures for the nineteen universities are extrapolated to include the other institutions in Canada receiving NSERC support.

In Table 2, the figure of $28,000 used to calculate the cost of the additional personnel required was obtained by dividing the costs reported for the present technical and professional support staff by the number of personnel. This average salary figure, therefore, includes the salaries and benefits of technical school and bachelor level graduates, as well as masters and doctoral graduates serving in a managerial capacity, and professional engineers.

The results obtained from the survey can be summarized as follows:

TABLE 2

Additional Infrastructure Needs Identified at the Nineteen Universities Surveyed

	Number	Annual Cost 1984 $
Additional Personnel Requested for the Departments	675	
Cost 675 x $28,000		$18.9 M
Additional Non-Salary Needs for the Departments		$ 8.3 M
Additional Personnel requested for the Central Service Facilities	109	
Cost 109 x $28,000		$ 3.1 M
Additional Non-salary needs for the Central Service Facilities	___	$ 1.4 M
Total Additional Needs	784	$31.7 M

To appreciate the significance of the figures presented above, it is necessary to review in more detail the responses received and the observations of the Task Force during the site visits.

Interpretation of the Definition of Infrastructure

On the whole, there was little problem with the definition of infrastructure as proposed by the Task Force. This does not mean that the respondents necessarily agreed with it, only that the definition was followed in

completing the questionnaire. Errors in interpretation in the personnel section usually involved the inclusion of secretaries, machine shop operators who were other than supervisory or advisory, persons in research administration, etc.

When such errors were discovered during the site visits, they were corrected before the questionnaires were processed.

In the non-salary section of the questionnaire, some relatively expensive equipment was included in a few instances, especially in relation to computing needs. Such costs were removed from the reported needs before the questionnaires were analyzed.

There were, unfortunately, considerable difficulties with the responses to Section F of the questionnaire which relates to the infrastructure-type needs of an individual faculty researcher, as distinct from a service for a number of research groups. It became clear during the visits that different respondents had interpreted these questions in different ways.

What the Task Force had in mind in devising this Section can be illustrated by the following example: In a large Chemistry Department, an x-ray diffraction unit may be used by a large proportion of its faculty members; the technical support for the unit is therefore considered an infrastructure cost and should have been included in the responses to Sections B and C of the questionnaire. In a smaller department, where an x-ray diffraction unit is used by an individual faculty researcher, the technical support is not strictly infrastructure as defined in our study, and respondents were expected to include such personnel in Section F.

During the visits, however, it became apparent that some respondents were often including personal technicians. Also, some who did not understand what was intended in this Section simply left the questions blank. The visits clearly indicated that there is a real need in this area; however, the need could not be quantified from the responses to the questionnaire.

It should be noted that none of the personnel reported in response to the questions in Section F have been included in the totals given in this Chapter. This reinforces to the Task Force's conclusion that total needs are underestimated.

Departmental Responses - Totals

Table 3 summarizes the key elements of the departmental responses to the questionnaire for the nineteen universities, both in total and grouped by region. In addition, certain relationships derived from the responses are presented. Since NSERC funding in 1983-84 to these universities constituted 66 percent of the Council's funding for all Canadian universities, the responses are readily converted to corresponding figures for the whole university system (see Chapter 7, page 40).

TABLE 3

Departmental Responses Tabulated by Region

Questionnaire Number		TOTAL	Atlantic Provinces	British Columbia	Ontario	Prairies	Quebec
Q1.4	Total Research Funding (M)	$ 219.2	$ 23.8	$ 25.6	$ 60.4	$ 64.6	$ 44.8
Q1.5	NSERC Funding (M)	$ 116.6	$ 13.2	$ 18.0	$ 33.5	$ 30.3	$ 21.6
Q2.1	Faculty	4370	638	586	1053	1246	846
Q2.2	Graduate Students	9601	1048	1292	2569	2312	2379
Q2.4	Postdoctoral Fellows & Research Associates	1675	163	221	422	491	278
Q2.5	FTE Technical Staff	3164	416	377	642	1094	634
Q2.6	FTE Infrastructure Staff	1363	152	165	231	512	303
Q3.1	FTE Infras. for NSERC Projects	944	114	144	183	303	200
Q3.2	3.1 Paid from NSERC Funds	259	25	42	57	81	54
Q3.3	3.1 Paid from Univ. Funds	612	79	95	112	205	122
Q3.4	3.1 Paid from Other Sources	73	10	7	14	17	24
Q5.1	FTE Needed for NSERC Projects	1618	206	228	345	472	368
Q6	Additional FTE required (5.1 - 3.1)	675	92	85	163	169	169
Q9	Non-Salary Expend. (M) for NSERC Projects	$ 11.2	$ 1.1	$ 1.4	$ 2.7	$ 3.6	$ 2.3
Q10	Additional Non-Salary Needs for NSERC Projects (M)	$ 8.3	$ 1.0	$ 0.8	$ 1.9	$ 2.3	$ 2.1
Q2.5/Q1.4	FTE per Million Dollars	14.4	17.5	14.7	10.6	16.9	14.2
Q2.6/Q1.4	FTE per Million Dollars	6.2	6.4	6.4	3.8	7.9	6.8
Q3.1/Q1.5	FTE per Million Dollars	8.1	8.6	8.0	5.5	10.1	9.3
Q5.1/Q1.5	FTE per Million Dollars	13.9	15.6	12.7	10.3	15.6	17.0
Q3.3/Q3.2	FTE University Funded / FTE NSERC Funded	2.4	3.2	2.3	2.0	2.5	2.3
Q9/Q1.5	Non-Salary Expenditures / NSERC Research Dollar	0.09	0.08	0.07	0.08	0.11	0.10
(Q9+Q10)/ Q1.5	Total Non-Salary Needs / NSERC Research Dollar	0.16	0.15	0.12	0.13	0.19	0.20

The results of the survey showed that the number of infrastructure personnel in the nineteen institutions currently working in research departments (as distinct from central service units) is 1363. Of these, 944 are associated with NSERC projects and programs. This latter number may be further divided into 612 (65 percent) paid from university funds, 259 (27 percent) paid from NSERC funds and 73 (8 percent) paid from other sources. The ratio of the number paid from each of the first two sources (Q3.3/Q3.2) is 2.4. Clearly, at least in this area, the universities continue to carry a large proportion of infrastructure costs.

In response to Q5.1 and Q6, the departments defined their additional full-time equivalent (FTE) infrastructure personnel needs for NSERC projects or programs as 675, which represents an increase of 72 percent over the present number. Although this increase may seem high, the Task Force is convinced that in relation to real needs the number is conservative. No allowance has been made for growth in the overall level of research activity in the universities, for the development of new programs in emerging areas of scientific and technological opportunity or for the rapid technological change in scientific instrumentation, including the introduction of sophisticated on-line computer systems to run new equipment. Neither has recognition been given to the costs associated with changing health and safety and animal care regulations. Furthermore, as a result of its visits, the Task Force removed a number of persons reported under Q5.1 (FTE Needed) in those cases where its definitions had clearly been misinterpreted. Also, in a few instances, the Task Force reduced requests which seemed excessive in relation to other comparable units and where the numbers were unsubstantiated. All of these factors will tend to cause the needs to be understated.

A useful basis for comparison of infrastructure personnel currently associated with or needed for research is to express their numbers in terms of millions of dollars of research funding. On this basis, one finds that the number of infrastructure personnel **needed** to support NSERC-sponsored projects and programs (Q5.1/Q1.5) is 13.9 FTE per $1 M of funding compared to the **present** number of 8.1 FTE per $1 M of funding (Q3.1/Q1.5).

Current non-salary infrastructure expenditures for NSERC projects and programs are $11.2 M, which corresponds to 9 percent of the total NSERC research funding (Q9/Q1.5). The **additional** non-salary infrastructure needs indicated in the departmental responses are $8.3 M, which, if provided, would result in the expenditures in this category increasing to 16 percent of the total NSERC research funding ((Q9+Q10)/Q1.5).

The Task Force believes that the needs in the non-salary infrastructure area have also been underestimated. First, to the Task Force's surprise, very little has been requested for service contracts, yet, as demonstrated during the visits, few departments currently have adequate technical support to maintain present equipment. Presumably, some of the additional personnel requested will meet the need for servicing equipment. Second, some departments did not include

the cost of replacement parts or upgrading for equipment. There has been no money for such items in existing budgets and chairmen simply are not accustomed to thinking in terms of preventive maintenance and critical part replacement policies. Unfortunately, the result is a general deterioration of equipment to the point where new equipment must be purchased rather than repairing the old. The fact that it is often easier to obtain financial support for the purchase of new equipment rather than for equipment upgrading reinforces the problem.

By contrast with the university situation, the Task Force notes that the use of service contracts is much more extensive in industry. Also, preventive maintenance programs tend to be better implemented in the industrial sector.

Regional Variations in Departmental Responses

The ratios shown in the last seven lines of Table 3 provide useful comparisons, by region, of current infrastructure support and needs. With the clear exception of Ontario, the ratios of **total** technical staff per million of **total** research funding (Q2.5/Q1.4), **infrastructure** technical staff per million of **total** research funding (Q2.6/Q1.4), and **infrastructure** technical staff for **NSERC** projects or programs per million of **NSERC** funding (Q3.1/Q1.5) are fairly uniform from region to region. Ontario, however, stands out as being very low in relation to the other regions in all categories. Furthermore, not only is the ratio of infrastructure technical staff for NSERC projects per million of NSERC funding for Ontario only 60 percent of that for the rest of the country, but the proportion of these staff funded by the university is also lower than in any other region (Q3.3/Q3.2). A major reason for the anomalous position of Ontario can be found in Table 10 of Chapter 6, which shows the recent funding history of the universities by province.

In comparing the indicated infrastructure technical staff needs per million dollars of research funding (Q5.1/Q1.5) with levels of support currently available (Q3.1/Q1.5), there is some indication that the greater the number of infrastructure personnel universities have, the greater the number they believe they need. There are a number of possible explanations for this. One may relate to the factor of institutional size which, to some extent, is superimposed on regionality. A second may be that a lower relative level of funding through operating grants may have prompted some respondents to seek increased funding through infrastructure support. A third explanation may be that it is precisely those institutions that have had the greatest experience with infrastructure staff which most fully appreciate their impact on research productivity. They are in a good position to know how additional staff can be effectively used.

Departmental Responses By Size of Institution

Questionnaire responses and data analyses tabulated by size of university are shown in Table 4. For the purpose of this report, small universities are defined as those whose total NSERC funding is less than $3 M, medium-size universities range from $3 M to $8 M and large universities have funding in excess of $8 M.

While there are apparent differences in some of the ratios, especially Q3.1/Q1.5, Q5.1/Q1.5, Q9/Q1.5 and (Q9+Q10)/Q1.5, it is not clear that these can be attributed to size. There is a strong overlay of regional differences which may, more than the factor of size, be responsible for the smaller average ratios for the large institutions. This latter point is demonstrated in Table 5 which shows the questionnaire responses and ratios for the five large institutions. Again, the unenviable position of the Ontario universities with respect to infrastructure personnel associated with NSERC projects per million of NSERC funding (Q3.1/Q1.5) is clearly demonstrated.

Insofar as non-salary infrastructure needs are concerned, it can be seen that the sampled institutions in Québec and in the Prairies not only have the highest current level of expenditures in this category, but also have indicated the highest total needs (Q9/Q1.5 and (Q9+Q10)/Q1.5).

Departmental Responses by Discipline

Table 6 shows departmental responses and ratios grouped by major discipline areas. The Task Force appreciates that some of the relationships may be obscured by the grouping of disciplines. A case in point is Mathematics and Computer Sciences for which infrastructure requirements differ greatly. Unfortunately, departmental structures provided no other choice.

Again, attention is drawn to the ratios presented in the lower part of Table 6. There are a number of striking differences, one of which is the relatively low current number of infrastructure support staff for Chemistry in relation to research funding levels (Q2.5/Q1.4, Q2.6/Q1.4 and Q3.1/Q1.5). On the other hand, the **total** number of technical support staff (infrastructure and personal technicians) per **total** research dollar (Q2.5/Q1.4) for Biology is very high at 20.9, clearly reflecting the special needs of the discipline. The ratios for Mathematics and Computer Science result from the combination of the relatively low requirements for the former discipline with the high requirements (as demonstrated by current Infrastructure I funding levels) for the latter. These ratios must always be viewed in terms of the Task Force's restricted definition of infrastructure.

It is of interest to note that the total infrastructure personnel needs associated with NSERC projects and programs (Q5.1/Q1.5) are between 50 and 80 percent above present levels (Q3.1/Q1.5). Needs range from 10.2 FTE per million dollars of NSERC research funding for Chemistry to 18.2 for Earth Sciences.

TABLE 4

Departmental Responses Tabulated by University Size

Questionnaire Number		TOTAL	Large	Medium	Small
Q1.4	Total Research Funding (M)	$ 219.2	$ 115.3	$ 80.5	$ 23.5
Q1.5	NSERC Funding (M)	$ 116.6	$ 66.7	$ 40.0	$ 10.9
Q2.1	Faculty	4370	2059	1781	529
Q2.2	Graduate Students	9601	4911	3657	1033
Q2.4	Postdoctoral Fellows & Research Associates	1675	911	537	127
Q2.5	FTE Technical Staff	3164	1448	1353	362
Q2.6	FTE Infrastructure Staff	1363	631	608	124
Q3.1	FTE Infras. for NSERC Projects	944	450	411	83
Q3.2	3.1 Paid from NSERC Funds	259	127	115	17
Q3.3	3.1 Paid from Univ. Funds	612	290	263	59
Q3.4	3.1 Paid from Other Sources	73	33	33	8
Q5.1	FTE Needed for NSERC Projects	1618	758	681	178
Q6	Additional FTE required (5.1 - 3.1)	675	308	271	97
Q9	Non-Salary Expend. (M) for NSERC Projects	$ 11.2	$ 5.2	$ 4.8	$ 1.2
Q10	Additional Non-Salary Needs for NSERC Projects (M)	$ 8.3	$ 3.6	$ 3.6	$ 1.1
Q2.5/Q1.4	FTE per Million Dollars	14.4	12.6	16.8	15.4
Q2.6/Q1.4	FTE per Million Dollars	6.2	5.5	7.6	5.3
Q3.1/Q1.5	FTE per Million Dollars	8.1	6.7	10.3	7.6
Q5.1/Q1.5	FTE per Million Dollars	13.9	11.4	17.0	16.3
Q3.3/Q3.2	FTE University funded / FTE NSERC funded	2.4	2.3	2.3	3.5
Q9/Q1.5	Non-Salary Expenditures / NSERC Research Dollar	0.09	0.07	0.12	0.11
(Q9+Q10)/ Q1.5	Total Non-Salary Needs / NSERC Research Dollar	0.16	0.13	0.21	0.21

TABLE 5

Departmental Responses Tabulated for Five Large Universities

Questionnaire Number		U.B.C.	Alberta	McMaster	Toronto	McGill
Q1.4	Total Research Funding (M)	$ 21.8	$ 21.9	$ 12.5	$ 38.7	$ 20.3
Q1.5	NSERC Funding (M)	$ 15.2	$ 11.6	$ 8.2	$ 20.9	$ 9.9
Q2.1	Faculty	449	397	241	604	368
Q2.2	Graduate Students	1100	660	568	1515	1069
Q2.4	Postdoctoral Fellows & Research Associates	181	218	106	246	161
Q2.5	FTE Technical Staff	309	383	153	377	225
Q2.6	FTE Infrastructure Staff	141	190	59	134	107
Q3.1	FTE Infras. for NSERC Projects	122	102	42	112	73
Q3.2	3.1 Paid from NSERC Funds	35	13	20	34	26
Q3.3	3.1 Paid from Univ. Funds	80	85	18	69	38
Q3.4	3.1 Paid from Other Sources	7	4	4	9	9
Q5.1	FTE Needed for NSERC Projects	191	140	82	202	144
Q6	Additional FTE required (5.1 - 3.1)	69	38	40	90	71
Q9	Non-Salary Expend. (M) for NSERC Projects	$ 1.0	$ 0.7	$ 1.0	$ 1.2	$ 1.3
Q10	Additional Non-Salary Needs for NSERC Projects (M)	$ 0.7	$ 0.4	$ 0.8	$ 1.0	$ 0.8
Q2.5/Q1.4	FTE per Million Dollars	14.2	17.5	12.3	9.7	11.1
Q2.6/Q1.4	FTE per Million Dollars	6.5	8.7	4.7	3.5	5.3
Q3.1/Q1.5	FTE per Million Dollars	8.0	8.8	5.1	5.4	7.4
Q5.1/Q1.5	FTE per Million Dollars	12.6	12.1	10.0	9.7	14.5
Q3.3/Q3.2	FTE University Funded / FTE NSERC Funded	2.3	6.5	0.9	2.0	1.5
Q9/Q1.5	Non-Salary Expenditures / NSERC Research Dollar	0.06	0.06	0.12	0.05	0.13
(Q9+Q10)/ Q1.5	Total Non-Salary Needs / NSERC Research Dollar	0.11	0.09	0.21	0.10	0.21

TABLE 6

Departmental Responses Tabulated by Discipline

Questionnaire Number		TOTAL	Biology	Chemistry	Earth Sc.	Eng.	Math & Comp. Sc.	Physics
Q1.4	Total Research Funding (M)	$ 219.2	$ 64.6	$ 30.1	$ 18.4	$ 62.3	$ 8.9	$ 34.9
Q1.5	NSERC Funding (M)	$ 116.6	$ 28.6	$ 16.6	$ 8.4	$ 30.8	$ 8.1	$ 24.0
Q2.1	Faculty	4370	1318	440	328	1121	615	548
Q2.2	Graduate Students	9601	3149	910	804	3156	643	938
Q2.4	Postdoctoral Fellows & Research Associates	1676	383	404	100	336	72	280
Q2.5	FTE Technical Staff	3164	1348	308	272	767	75	393
Q2.6	FTE Infrastructure Staff	1363	491	142	129	350	48	203
Q3.1	FTE Infra. for NSERC Projects	944	280	111	87	249	40	177
Q3.2	3.1 Paid from NSERC Funds	259	63	12	20	56	30	76
Q3.3	3.1 Paid from Univ. Funds	612	200	92	57	168	7	89
Q3.4	3.1 Paid from Other Sources	73	17	6	11	24	3	12
Q5.1	FTE Needed for NSERC Projects	1618	475	170	153	466	88	267
Q6	Additional FTE required (5.1 - 3.1)	675	195	60	66	217	47	90
Q9	Non-Salary Expend. (M) for NSERC Projects	$ 11.2	$ 3.3	$ 1.2	$ 0.8	$ 2.4	$ 1.2	$ 2.4
Q10	Additional Non-Salary Needs for NSERC Projects (M)	$ 8.3	$ 1.8	$ 0.9	$ 0.8	$ 2.6	$ 0.6	$ 1.6
Q2.5/Q1.4	FTE per Million Dollars	14.4	20.9	10.2	14.8	12.3	8.4	11.3
Q2.6/Q1.4	FTE per Million Dollars	6.2	7.6	4.7	7.0	5.6	5.4	5.8
Q3.1/Q1.5	FTE per Million Dollars	8.1	9.8	6.7	10.3	8.1	4.9	7.4
Q5.1/Q1.5	FTE per Million Dollars	13.9	16.6	10.2	18.2	15.1	10.9	11.1
Q3.3/Q3.2	FTE University Funded / FTE NSERC Funded	2.4	3.2	7.7	2.9	3.0	0.23	1.2
Q9/Q1.5	Non-Salary Expenditures / NSERC Research Dollar	0.09	0.1	0.07	0.09	0.07	0.14	0.10
(Q9+Q10)/ Q1.5	Total Non-Salary Needs / NSERC Research Dollar	0.16	0.17	0.12	0.19	0.16	0.22	0.16

Of special significance is the ratio of university-funded to NSERC-funded infrastructure support staff associated with NSERC projects and programs (Q3.3/Q3.2). The ratio is relatively high for Chemistry at 7.7, intermediate for Biology, Earth Sciences and Engineering at about 3 and very low for Physics at 1.2 and Mathematics and Computer Science at 0.23. The latter, particularly, stands out and is a consequence of the fact that, despite the high infrastructure personnel needs of Computer Science, little funding support is coming from the universities. Unfortunately, this discipline developed after university funding pressures had intensified. The Task Force believes that it is important for NSERC to develop an infrastructure funding program that will assist universities in addressing these inequities. Chapter 8 of the report deals with this issue.

Trends in Departmental Infrastructure Staff by Source of Funding 1981-82 to 1983-84

Trends in the total number of infrastructure staff associated with NSERC projects and programs and in the number paid from each of the three funding sources (NSERC grants, university operating budgets and others) for the years 1981-82, 1982-83 and 1983-84, are shown in Table 7 (by region) and in Table 8 (by discipline). It was not practical to seek comparative information for earlier years and, indeed, a few departments were unable to provide information for all three years. Responses from these departments are not included in the tabulation. Small discrepancies in totals are due to rounding to the nearest FTE.

The one clear trend is in the total number of infrastructure staff, which increased from 853 to 946 at the nineteen universities over the three-year period. While there has been a 45 percent increase in NSERC-funded personnel over this period, the number funded from university operating budgets has remained essentially constant. Contributing to the former has been the higher level of funding in the NSERC infrastructure program in recent years as well as substantial increases in both the operating and strategic grants programs.

By discipline, the largest increases have been in NSERC-funded personnel in Engineering, and in Mathematics and Computer Science. Especially striking has been the increase from 8 to 30 persons in the case of the latter disciplines, reflecting extensive use of the current program by the Computing and Information Science GSC. Also of interest is the apparent transfer in the funding of a number of infrastructure personnel in Physics from university operating budgets to NSERC grants.

Central Service Facilities

It is clear from the responses to the questionnaire and from the visits, that services such as machine shops, electronic shops, etc. that are centralized at the university or faculty level in one institution are at the departmental level in another. This had an influence on the response rates for such services. It was not unusual for the site visit teams to discover that

TABLE 7

THREE-YEAR DEPARTMENTAL TRENDS BY REGION

Number of:	TOTAL	Atlantic Provinces	British Columbia	Ontario	Prairies	Quebec
Infra staff-NSERC projects 83-84	946	114	146	183	303	200
Infra staff-NSERC projects 82-83	911	112	143	182	286	189
Infra staff-NSERC projects 81-82	853	105	126	168	279	175
Paid from NSERC grants 83-84	257	25	41	57	80	54
Paid from NSERC grants 82-83	211	22	35	47	63	44
Paid from NSERC grants 81-82	178	22	25	35	57	38
Paid from Univ. funds 83-84	614	79	97	112	205	122
Paid from Univ. funds 82-83	630	81	100	122	207	120
Paid from Univ. funds 81-82	613	75	92	122	207	116
Paid from other sources 83-84	74	10	7	14	17	24
Paid from other sources 82-83	71	8	8	13	16	25
Paid from other sources 81-82	63	8	8	11	15	21

Footnote: Numbers for 1983-84 differ slightly from numbers reported elsewhere in this document since, for reasons of comparability, data was only compiled from questionnaires where information on all three years was reported.

TABLE 8

THREE-YEAR DEPARTMENTAL TRENDS BY DISCIPLINE

Number of:	TOTAL	Biology	Chemistry	Earth Sc.	Engineering	Math & Comp. Sc.	Physics
Infra staff-NSERC projects 83-84	946	280	111	87	251	40	177
Infra staff-NSERC projects 82-83	911	266	116	82	240	30	178
Infra staff-NSERC projects 81-82	853	256	117	79	220	17	164
Paid from NSERC grants 83-84	257	63	12	20	56	30	76
Paid from NSERC grants 82-83	211	57	11	16	43	18	66
Paid from NSERC grants 81-82	178	56	14	13	35	8	53
Paid from Univ. funds 83-84	614	200	92	56	170	7	89
Paid from Univ. funds 82-83	630	192	100	58	173	7	99
Paid from Univ. funds 81-82	613	187	99	58	166	5	99
Paid from other sources 83-84	74	17	6	11	24	3	12
Paid from other sources 82-83	71	17	4	9	24	5	12
Paid from other sources 81-82	63	14	4	8	19	5	13

Footnote: Numbers for 1983-84 differ slightly from numbers reported elsewhere in this document since, for reasons of comparability, data was only compiled from questionnaires where information on all three years was reported.

omissions had been made in the list of responses for university level central services. However, the number of units omitted, the Task Force believes, is not large and will have only a minor effect on the overall picture. Nevertheless, once again, needs as determined from the survey will tend to be understated.

Table 9 summarizes the key elements of the questionnaire responses related to central services, both in total and grouped by region. It is seen that, for the nineteen universities surveyed, there is a total staff of 1308 associated with central services of which 387 are of an infrastructure-type as defined in the questionnaire. Of these, 289 (75 percent) are paid from university funds (although in certain instances there may be some cost recovery from research grants) and 72 (20 percent) are paid from NSERC funds. Additional infrastructure personnel needed has been reported as 109, which represents an increase of 28 percent above the current level.

The non-salary infrastructure needs reported for central services were in general modest. For the nineteen institutions, current expenditures in this category were $8.9 M and an additional need of $1.4 M was identified.

Central service infrastructure needs, both for salaried personnel and non-salary expenditures, clearly are small in relation to needs at the departmental level.

The data on central services by region again demonstrate the relatively low level of support in the Province of Ontario. As demonstrated in Table 9, for this province only, a larger fraction of the costs associated with central services are being funded by NSERC than by the universities. Although trends in support of central services were not sought in the questionnaire, it became very apparent during the visits that the extent and level of charges for central services against grants is increasing. Some universities have only recently introduced charges, while others have increased charges to the point of seeking full cost recovery.

Some Useful Comparisons

The general information section of the questionnaire provided the Task Force with an interesting profile of researchers in departments supported by NSERC. Each professor engaged in research has on average 2.2 graduate students, 0.4 postdoctoral fellows or research associates and 0.7 technicians. Adding to the total number of technical and professional research support staff at the departmental level the staff serving in a research infrastructure capacity in central services, the technician-professor ratio is 0.8. The average sponsored research funding from all sources per faculty researcher is $26,700. This figure is somewhat low since, from the visits, it is known that some respondents did not include equipment grants.

TABLE 9

Central Service Facilities - Responses Tabulated by Region

Questionnaire Number		TOTAL	Atlantic Provinces	British Columbia	Ontario	Prairies	Quebec
1.4	Total Staff	1308	213	246	218	371	260
2.1	Infrastructure Staff	387	67	62	68	130	60
2.2	2.1 Paid from NSERC	72	5	5	34	18	11
2.3	2.1 Paid from University	289	59	56	29	98	46
2.4	2.1 Paid from Other Sources	26	3	1	5	15	3
4.1	Total Infrastructure Staff Needed	496	79	82	79	167	89
5.	Additional Infrastructure Needed	109	12	20	11	37	29
8.	Non-Salary Expend. (M)	$ 8.9	$ 2.7	$ 2.6	$ 1.1	$ 1.9	$ 0.5
9.	Additional Non-Salary Needs (M)	$ 1.4	$ 0.4	$ 0.2	$ 0.2	$ 0.3	$ 0.2

It is instructive to compare the number of technical support staff per FTE researcher in university, government and industrial research settings. This is difficult to do with any accuracy because of the differences in the way in which research is performed in the three sectors. Faculty have teaching and administrative duties as well as the responsibility for carrying out research, while graduate students are full-time researchers only in the later years of doctoral study. Furthermore, while graduate students may perform functions which would be assigned to technical staff in government or industrial research laboratories, they also require time-consuming training and supervision by infrastructure personnel in the operation and maintenance of research equipment. On the other hand, industrial research laboratories employ a considerable number of bachelor's degree holders, some of whom carry out research while others provide technical support of one kind or another.

At the National Research Council of Canada, where the research activities cover the same disciplines as those supported by NSERC, the technician to FTE researcher ratio is approximately 0.8. In arriving at this figure, postdoctoral fellows and research associates are counted as full-time researchers.

A survey of three industrial research laboratories in the Sheridan Park Complex in Mississauga, Ontario, gave an overall technician to FTE researcher ratio of 1.1. In making this calculation, the assumption is made that one-half of the bachelors graduates in these laboratories serve as full-time researchers and one-half perform technical support functions.

In universities, research faculty and graduate students are considered, on average, to devote one-half of their time over the calendar year to research. This may be low since the four summer months are usually devoted fully to this activity. Postdoctoral fellows and research associates, as in the case of NRC, are counted as full-time researchers. Using these assumptions and counting the total technical and professional research support staff at the departmental level and only the research infrastructure personnel in central services (others in central services are associated mainly with undergraduate needs), the technician to FTE researcher ratio in universities in the natural sciences and engineering is 0.4.

While these comparisons are approximate at best, they do serve to show that there are fewer technical and professional staff associated with university research than is the case in government and industry. While there is no reason why the ratio of technicians to FTE researchers should be the same in universities as in the two other sectors, the large discrepancy lends support to the Task Force's conclusion that both the effectiveness and efficiency with which university research is carried out is being seriously undermined because of inadequate technical and professional support services. It is of interest to note that even if the recommendations contained in this report (see Chapter 7) were implemented, the ratio of technicians to FTE researchers would only increase from 0.4 to 0.5.

Chapter 4

EXAMINATION OF THE EXISTING INFRASTRUCTURE GRANTS PROGRAM

The effectiveness of NSERC's present infrastructure program must be examined in light of the overall needs of the research community.

The present program is an outgrowth of the previous core grants program which was expanded in 1981 to include specialized research resources, such as large or special items of equipment, specialized research facilities or a core of highly skilled research support staff essential to the maintenance of the research activities of a number of researchers. This represents an addition to the original core grants program which provided support only for the maintenance and operation of special facilities.

Concern with Skilled Services and Collections of Equipment

The expansion of the core grants program into the present infrastructure grants program was based on a concern expressed by Council's committees that specialized technical resources and special research facilities were not eligible for support under the core grants program. While some disciplines such as nuclear physics and astronomy rely heavily on major facilities, others such as biology and computer science rely on specialized research assistance as the "infrastructure" for a group of researchers.

With the expansion of the program, however, certain restrictions of the former core grants program were retained, i.e., the facility should not be standard in a discipline and present in many university departments, and it would be unreasonable to expect adequate support from user fees, operating grants or other sources.

Present Program

A detailed program description is appended (Appendix H). At the time of the change in program description, there was also a change in the mode of evaluation. Although NSERC has only one infrastructure program, applications are handled in one of two ways for purposes of review and budget allocation.

TYPE I — All applications which are relatively small in magnitude (less than $100k) and relatively unidisciplinary in focus are classified as type I and are assigned directly to a grant selection committee for review. Except for nuclear physics, 25% of the recommended funding must be found from within the GSC allocation; 75% comes from the Council reserve. For historical reasons, and because of the close relationship of operating and infrastructure funding, the Nuclear Science GSC receives an allocation from which funding recommendations for all of the low-energy facilities are made. This funding scheme has been in place since the February 1982 competition.

TYPE II Applications are classified as type II if they fall into one or more of the following categories:

- a very high level of funding requested (e.g. $100k and above per annum);
- the users of the research resource or facility span a number of discipline areas;
- the facility is not easily reviewed by one of the discipline committees;
- the infrastructure application is submitted concurrently with a request for a major installation grant (or in some cases a major equipment grant).

In these cases, grant selection committees are asked to comment on the infrastructure grant applications as is done for major installation grant applications, but the major review is carried out by an **ad hoc** visiting committee or an **ad hoc** review committee which examines a number of similar applications at the same time. Funding recommendations are made by the Committee on Grants and Scholarships and no contribution is required from grant selection committee budgets. Individual members of grant selection committees may be asked to participate in site visits as appropriate.

Funding Trends

Over the three years since the program was modified there has been a significant increase in the level of infrastructure funding by NSERC. Appendix I contains two tables, one describing the distribution of infrastructure support (in comparison with requests) by discipline committee, the other describing the nature of the type II facilities supported. As indicated below, funding has increased sharply since the expansion of the core grants program.

Fiscal Year	Infrastructure Funding	Total NSERC Research Budget
1979-80	$ 3.65 M (core program)	120.7 M
1980-81	$ 4.28 M (core program)	162.3 M
1981-82	$ 4.93 M (core program)	201.1 M
1982-83	$ 7.95 M	244.4 M
1983-84	$10.22 M	281.2 M
1984-85	$12.71 M	291.6 M

Furthermore, in most discipline areas the number of infrastructure requests has risen sharply from 117 in 1982-83 to 210 in 1984-85. It should be noted that approximately 60% of the total infrastructure funding continues to be allocated to such major facilities as the nuclear science accelerators and the major facilities funded through type II infrastructure grants (e.g. slowpokes, field stations, marine facilities, the McMaster nuclear reactor and major new facilities).

Since the present infrastructure program is confined to specialized research resources, it covers only a small fraction of the costs of operation and maintenance of equipment. As stated earlier, facilities standard in a discipline and present in many university departments are not eligible. It must be realized that, in some disciplines, there are relatively few facilities which could be classified as non-standard for the discipline. These standard facilities may, however, be quite expensive and sophisticated and require skilled technical personnel and maintenance. Examples of this type of facility would be cryogenic apparatus, a variety of electron microscopes, laser facilities, etc. These are not normally supported under the present infrastructure grants program.

As was pointed out in the introduction of the report, the problem of funding facilities standard in a discipline is increasing. Many facilities which were "unique" a few years ago can no longer be considered unique as similar specialized major equipment or installations have been acquired by many universities.

Overall Assessment

While the present program is generally effective in providing support for very specialized resources and facilities, it does not address the more general and urgent need for technical support and maintenance of shared equipment or standard facilities. This need had already been pointed out in 1981 by the Task Force on Research Equipment which recommended that: "NSERC should increase the level of funds committed to maintenance and technician support for research equipment through expanded use of the Core program." This recommendation was made in recognition of the increasing frequency with which equipment already in the field is not being fully used owing to inadequate technical support and/or maintenance, and in recognition of the growing importance of proper maintenance and high quality technical support for sophisticated research equipment.

A separate issue, apart from the restrictive nature of the program, is the problem of consistency in interpretation of the program criteria and guidelines by a large community and by twenty different grant selection committees. Not only is there a wide variation in the number of applications from one discipline to another, but there is also a wide variation in the way in which committees interpret the program guidelines. Some committees tend to

recommend funding for national or regional facilities. Others will fund only special colonies of animals or genetic material. Still others, notably Computing and Information Science, see the infrastructure grants program as a major mechanism for the funding of technical support to both "unique" centres and to those centres which are in a developmental stage. As a result of the latter approach, the funding provided to sixteen Computing Science facilities across the country now totals approximately $1.4 million.

Another problem associated with the present infrastructure grants program is that committees traditionally have not been able to respond to actual research costs when evaluating grant applications. Although this has been the case in the operating grants program particularly, it also affects the infrastructure grants program. For instance, some committees are reluctant to recommend support for professional technical staff or maintenance contracts; other committees have difficulties determining which facilities can be considered "specialized resources" for their disciplines. This is no easy task, given limited funding, the rapidly evolving nature of the technology in the disciplines and the changing membership of these committees, compounded by the fact that the researchers themselves are often unable to determine whether their facilities meet the program criteria. As this process continues, the major variation in approach to the infrastructure program which now exists may lessen, but it will not be eliminated for the various reasons outlined above.

The Task Force will be proposing a modification to the present approach to infrastructure funding to address the problem of maintenance and operation of standard equipment. This is the subject of Chapter 8 of this Report.

Chapter 5

CENTRALIZATION vs DECENTRALIZATION OF TECHNICAL SERVICES

The third term of reference requires the Task Force to "examine the relative effectiveness and economy of centrally-operated and centrally-funded equipment maintenance and technical services as distinct from other patterns of operation".

Two approaches were used to obtain information related to this term of reference. First, each of the nineteen universities in the sample was asked to report separately on every service that was centrally operated.

Second, each site visit team was instructed to enquire about the effectiveness and efficiency of the operation of the central service units and the degree to which charge-back systems are used.

Centralization at the Institutional Level

Although there is a variation from institution to institution, the degree of centralization at the university level increases as the size of the institution decreases. For example, three or four electron microscopes may be placed in a central unit for science and engineering departments at a small to medium size university, but the same arrangement would not be appropriate for a larger university with several such instruments in each of a number of departments. When a department's use of a facility reaches a certain level, it is more efficient for the service to be located in the department rather than as part of a centralized unit. Another factor which affects the degree of centralization is the historical development of departments in some institutions. Departments do not willingly give up equipment or services that are in their control.

Certain services lend themselves to centralization at the university or faculty level. The discussion which follows distinguishes between the services which are truly central and those which are more commonly operated at the departmental level.

Central Services

Computer services, statistical services, animal care facilities and large machine shops are examples of the kind of service that is centralized to a greater or lesser extent in every university. Most universities have a central computing centre, in part because of the cost of hardware in the early days of the service. Animal care is often centralized because only then can costly veterinary services and adequate housing be supported to meet the guidelines on care and housing of experimental animals established by the Canadian Council on Animal Care (CCAC).

Looking at these services only, the Task Force found no indication that there was any significant trend towards further centralization at the university level. While the university administration often viewed centralization as an effective and efficient way to provide services at a reasonable cost, this view was not necessarily shared by the researchers themselves. A problem cited by researchers was the remoteness of the central service, in some cases both in terms of location and knowledge of what was required by the researcher. It was frequently pointed out that different departments require specialized services which are difficult for a central unit to provide. For example, researchers frequently require design assistance for mechanical apparatus prior to machine shop fabrication. Also, the close working relationship that develops between the skilled personnel in departmental shops and the researchers makes possible a quality of service that may be unavailable in university-level shop units.

As might be expected, the view taken by the user of a centralized service was dependent, to a large extent, upon the manager of the service. When managers were capable and user-oriented, there was seldom pressure to dismantle or cut down on the centralized service. Also, it is recognized that university-level central facilities can often provide a broader range of expertise than is available in facilities other than those of very large departments.

Departmental Services

Although the Task Force found no trend towards further centralization at the university level, there has been considerable consolidation at the departmental level. There is every indication that experimental facilities are being brought together in large departments to increase efficiency. The Department of Biology at McGill University provides a good example of the innovative approaches that are being developed under the pressure of tight budgets, increased teaching loads and the need to find more cost-effective ways to operate and maintain sophisticated equipment. The Department has brought together light microscopy and photography into one unit. As well, there is a common electron microscope unit, instrument shop, etc. Each research group has given up something to be a part of a larger, more efficient whole. Some of the Department's units also provide services to other parts of the university. Nominal fees are charged to Departmental users and somewhat larger fees are charged to outside users including those from other departments.

An example of centralization within a large department is found in the Chemistry Department at the University of British Columbia. All grantees are expected to contribute 10% of their research grants to provide technical central services for the Department. The Department then hires the technical support to maintain and offer a very high level of research support services which include the design of state-of-the-art electronic equipment, the development of software programs, the provision of machine shop services, etc. This degree of centralization allows the Department to do without service contracts on equipment, and saves both funds and time.

Users have reported considerable satisfaction with services which have been consolidated within departments. Furthermore, it seems apparent that such consolidation is increasing and should be encouraged by NSERC, even to the extent of supporting seminars and workshops on this topic. The Task Force notes that present NSERC regulations (para. 203 of the 1984-85 Awards Guide) actually discourage arrangements such as those described in the previous paragraph. This regulation should be changed to permit pooling of up to 10% of NSERC grant funds on a voluntary basis.

Funding

During discussions with the universities, the Task Force became aware of a significant difference between facilities that were centrally-operated and those which were centrally-operated and centrally-funded. Centrally-operated facilities may receive funding from user fees, levies against grants, or a mixture of the two methods. Centrally-funded facilities are financed primarily with university-controlled funds.

With respect to the centrally-operated facilities, the charging of user fees is viewed quite differently from one institution to another. Many researchers view user fees as an admission that an institution has failed to provide proper support for research. Concern was expressed about the amount of paperwork involved in charge-back systems and the fact that user fees hurt the young researchers who do not have large research grants. Furthermore, the stability of funding can be in doubt from year to year, either because grantees can abruptly change their expenditure priorities or change institutions. On the other side of the user fee argument, however, there are institutions that feel that the use of fees is an effective way to control demand and to encourage the setting of priorities.

Regardless of the pros and cons of the user fee or the levy system, there is no doubt that charging for services that were previously supplied to researchers at no cost, is increasing. This increase is not dictated by any particular funding philosophy, but by funding pressures within the institutions. This trend has been confirmed in a recent study on animal care by the Canadian Council on Animal Care.

Computing Centre Issues

At each of the fifteen universities visited, particular attention was paid to the operation of the computing centre. In most cases, this was the largest of the central facilities and its services were in a state of flux. The Task Force was interested, of course, in the amount of infrastructure support required by the centre but also in the direction of the centre and the way it was financed.

On the whole, the centres were reasonably well supported although most needed more personnel. It is interesting to note that there are still many centres which are supported entirely by the university. Only a very few have charge-back systems that bring substantial funding to the unit in proportion to costs; most have only nominal charges. That the computing facility itself was in a state of flux was apparent both to the central administration and to the research community. Although there are exceptions, the general trend is towards a decentralization of computing services. Departments and faculties are acquiring a variety of computer systems that reduce the load on mainframe units. The central service is used more and more as an advisory service for hardware and software purchases, software licensing arrangements and as a consulting service for special research needs. To an increasing extent, however, the departments have a need for hardware and, in particular, software personnel who have specialized knowledge of their particular disciplines. As decentralization takes place, there is a need for networking which places an additional responsibility upon the central facility. Thus, the central service remains a very significant part of the whole and must be well supported.

The computer needs of every campus are growing at rapid rates and most of the infrastructure funding for central computer services is being provided by the universities. Any sudden change from this funding situation would have very serious consequences for research.

Statistical Services

Several universities now have central statistical consulting service units which promote the proper use of statistics in research. The Task Force made enquiries about such services during the site visits and a special visit was made to Queen's University to obtain insights into an established service (STATLAB) and to discuss the service with several users from other departments.

NSERC already provides infrastructure support to several statistical consulting services and thus recognizes their significance to researchers for planning experiments, determining sampling techniques and sample sizes, analyzing data, etc. The consulting services are often provided free to the users although some recovery of costs is made from non-university users and from contract research.

The Statistical Sciences Grant Selection Committee promotes the use of statistical consulting services for several reasons, including the:

- fostering of strong interactions between statisticians and researchers;
- promulgation of statistical thinking;
- development of strong applied statistics research in Canada, motivated by problems faced by active researchers.

The Committee deems it essential that the service be centrally-funded to ensure "stable funding which would enable a consulting service to provide statistical consulting at an appropriate level of service and quality".

In general, the Task Force agrees with the Grant Selection Committee and expects that requests to NSERC for support for centrally-funded statistical consulting services will increase.

Recommendation

NSERC funding policies should encourage the consolidation of research support services at the departmental level. This will require a change in the regulation (para. 203 of the 1984-85 Awards Guide) requiring the itemization of expenditures against individual grants and prohibiting the pooling of grant funds. Pooling of up to 10% of NSERC grant funds on a voluntary basis should be permitted. Such pooled resources could only be used in support of the direct costs of research and would be administered in accordance with NSERC regulations. As well, NSERC should consider supporting seminars and/or workshops on how to centralize these services effectively. Case studies of several successful operations could be used for this purpose.

Chapter 6

FUTURE TRENDS IN UNIVERSITY FUNDING

The fourth term of reference requires the Task Force "to examine the current situation and comment upon future trends in the division of responsibility for the support of research infrastructure between the provinces and the federal government". In order to respond to this term, the Task Force examined data concerning provincial grants to universities and the total sponsored research funding including that provided by NSERC. In addition, the Task Force discussed funding, past, present and future, with the administration of the universities which were visited. Also, as previously mentioned, three chairmen of provincial university grants committees were questioned about future funding for universities in their provinces.

Provincial Support

The funding history of the universities (by province) is given in Table 10, which is taken from the Fifth Report of the Tripartite Committee on Interprovincial Comparisons, January 1984, published by the Ontario Council on University Affairs. The table shows university operating grants plus fees per student from 1974-75 to 1981-82, the last year for which the data are complete. It is clear from the data that per student funding has decreased when inflation is taken into consideration and that funding in some provinces has been significantly curtailed.

Although precise figures have not been compiled on a per student basis from 1981-82 to the present, enrolments have increased and operating budgets in many provinces have not kept pace with inflation. Indeed, in one or two cases, provincial grants have been frozen or reduced. All of the above indicates that the universities have been and are going through a period of serious financial constraint. From the point of view of the Task Force, the question that must be raised is has this affected the ability of the universities to support research?

In a general way, the answer to the question is given in the introduction to this report. Table 1 on page 2 shows that while the total sponsored research and development funding in the universities has increased by 22.2%, the university's contribution to the research function, including the research component of faculty salaries, has decreased by 5.1% over the period 1979-84.

It is important to recognize that the increase in sponsored research funding received by the universities in recent years has exacerbated their financial problems. Grants and many contracts do not provide for overhead costs, nor do they take into account the salary costs of the faculty carrying out the research. Grants and contracts, therefore, draw on infrastructure services, yet they do not significantly contribute to the funding of these services. Clearly, the university that undertakes the most research in relation

TABLE 10

Provincial Operating Grants plus Fees per Student*
($)

	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
British Columbia	3,577.74	4,193.04	4,733.66	5,182.38	5,715.13	6,057.77	6,467.95	7,407.67
Alberta	3,838.53	4,525.15	4,838.60	5,371.44	6,023.98	6,613.04	7,593.89	8,317.73
Saskatchewan	3,692.21	4,237.64	4,608.81	5,048.64	5,662.23	6,231.91	6,378.39	6,822.46
Manitoba	3,030.44	3,579.42	3,995.83	4,440.91	4,779.61	5,422.73	5,482.78	5,967.64
Ontario	3,502.43	3,714.20	4,094.05	4,594.19	5,037.51	5,239.25	5,420.97	5,794.10
Quebec	3,642.53	4,372.94	4,743.11	5,164.80	5,347.21	5,889.84	6,682.59	7,009.33
New Brunswick	3,321.57	3,663.65	4,085.48	4,581.81	4,829.71	5,689.55	5,890.08	6,097.98
Nova Scotia	3,303.35	3,849.66	3,933.81	4,293.91	4,929.64	5,257.37	5,823.18	6,569.53
P.E.I.	3,218.73	3,360.12	3,394.19	3,255.86	4,417.63	4,972.97	5,073.01	5,565.54
Newfoundland	3,844.32	4,929.76	5,437.84	6,343.80	6,821.16	7,222.26	7,052.23	6,792.82
Canada	3,547.62	4,033.06	4,413.05	4,894.15	5,303.74	5,710.91	6,162.97	6,615.86

Note: Interprovincial transfer students and funds are included in the figures of the province from where they are enrolled.

* Taken from the Fifth Report of the Tripartite Committee on Interprovincial Comparisons, January, 1984.

to its operating budget is the most hard pressed. In this regard, Table 11 shows the wide variation in research grants versus normal operating income between the nineteen universities included in the Task Force survey.

TABLE 11

Sponsored Research Funding in Relation
to University Operating Budgets
(1982-83 Fiscal Year*)

University	General Operating Budget ($000)	Sponsored Research Funding ($000)	Research as a Percentage of General Operating (%)
Memorial	90,339	12,137	13.3
Dalhousie	80,539	10,982	13.6
St. Francis Xavier	14,411	825	5.7
TUNS	9,888	3,692	37.3
New Brunswick	55,048	10,533	19.1
École Polytechnique	30,662	8,055	26.2
Laval	191,945	30,930	16.1
McGill	149,487	50,081	33.5
Sherbrooke	73,381	16,140	21.9
Lakehead	23,930	2,510	10.4
McMaster	92,573	38,280	41.3
Ottawa	106,716	15,446	14.4
Toronto	303,546	78,705	25.9
Manitoba	131,165	30,604	23.3
Saskatchewan	102,540	16,962	16.5
Alberta	211,063	42,940	20.3
Calgary	125,323	27,977	22.3
British Columbia	207,782	46,611	22.4
Victoria	61,567	4,329	7.0

* From Financial Statistics of Universities and Colleges, 1982-83. Statistics Canada, Report 22D.

In the last few years, some provinces have increased their direct support for research through various ministries while at the same time constraining the university operating grants. This "targeted" research funding may become more common in future as provinces seek to direct the universities into activities thought to be in line with provincial priorities.

The Future

There is unanimity amongst senior administrators that universities will continue to have trouble supporting the infrastructure costs for research. It is increasingly difficult for institutions to protect the research enterprise when total student enrolment in science and engineering continues to climb. Technicians are required for the operation of undergraduate student laboratories, an activity which takes precedence over others. The students are there and the services are required - research must wait.

On the whole, this less than enthusiastic view of future funding was shared by the provincial university grants committee chairmen with whom the Task Force consulted. None of the committee chairmen expected the provinces to increase their funding substantially nor did they expect the provinces to earmark large sums for the support of university research. This statement must be qualified, however, because the Task Force did not visit provincial ministries and is aware that certain provinces are beginning to provide support for both basic and applied research in some of their institutions.

Overall, the funding future for universities in Canada does not appear to be one of growth. Indeed, severe restrictions are in effect in some provinces. The Task Force heard repeatedly that an NSERC initiative for infrastructure support has become absolutely essential.

small number of faculty researchers for a specific infrastructure requirement may not necessarily be employed 100 percent of their time and there is no strong inducement to offer unused time for other research activities within the department.

After careful consideration, the Task Force has come to the conclusion that, aside from the support of major facilities of a specialized nature, all infrastructure funding should be in the form of block grants to be calculated by using a formula that relates funding levels to the total NSERC funding in other grants programs. This approach can be expected to reduce duplication and encourage the efficient and flexible use of infrastructure funds. It should facilitate access to technical services by new young researchers and help ensure stability of funding for central services. It should also minimize paperwork for both the research community and NSERC committees.

Factors to be Considered in Any Allocation by Formula

In considering the most appropriate level or levels (department, faculty or university) at which infrastructure block funding by formula might be made, the Task Force took into account the following factors:

1. Services which are provided at the departmental level at some universities are centralized at the faculty or university level at others.

2. There is no close relationship between total infrastructure needs and total operating grants from discipline to discipline or even within a discipline from university to university.

3. The extent to which infrastructure needs are currently being met by technical support services funded by the university varies greatly from discipline to discipline.

4. Increasingly, equipment and technical services have multidisciplinary uses.

5. The larger the entity receiving NSERC infrastructure funds, the greater the flexibility it can exercise in the distribution of these funds to the appropriate research services.

A Proposal for Infrastructure Funding by Formula

The Task Force, after considering a number of options for infrastructure funding by formula (see Appendix J), including an allocation at the university level (as is now the case for the general research grant), an allocation at the faculty level, or an allocation at the departmental level, came to the conclusion that the most satisfactory arrangement would be one involving an equal distribution of funds between the university and departments.

Providing universities with a substantial allocation would give them the means to correct inequities in the distribution of infrastructure support which result either from the present level of university support or from anomalies arising out of departmental allocation mechanisms. They would then also be in a position to provide better support for centralized facilities, such as computing centres, animal quarters, shops, etc., to encourage the formation of high-quality interdepartmental research facilities and services, and to support new initiatives which require infrastructure funding.

On the other hand, providing some infrastructure support at the departmental level would deliver the funding close to the level of the researcher and, therefore, would achieve a direct correlation with excellence. Furthermore, decisions on the use of infrastructure funds would then be made at the grassroots level and should, therefore, be in tune with real needs. Finally, as most equipment and services are required at the departmental level, an allocation at that level should provide an incentive for efficiency.

Whether the allocation of infrastructure funds between the two levels should be 50:50 is, of course, open to question. This point was subject to considerable debate within the Task Force where some members supported a larger departmental allocation. In the case of small universities with highly centralized services and the need for a great deal of flexibility in the distribution of funds between departments, an argument can be made for having the total amount allocated at the university level. On the other hand, for large institutions, where most services are provided at the departmental level and where there may be a much closer correlation between infrastructure needs and NSERC grant funding, a larger allocation to departments might be justified. It would not seem very practical, however, to adjust the proportionality factor for each institution, depending on its special situation. It is the view of the Task Force that each university's internal mechanisms should be able to accommodate any anomalies that might arise from using a single factor.

Concerning the components of the funding base to be used to calculate the levels of infrastructure support, it appears reasonable to include all NSERC grants that generate an infrastructure requirement, i.e. individual and team operating grants, strategic grants, Project Research Applicable in Industry (PRAI grants), and other project grants, as well as a six-year average of regular equipment, major equipment and strategic equipment grants. Major installations, on the other hand, should not be included in the base since to do so would cause major distortions in the funding levels for individual universities and departments. Furthermore, such installations usually come under the category of a "major facility of a specialized nature" and, therefore, would be eligible for infrastructure support by application.

research. Both of these factors will increase the pressures on infrastructure resources of the institutions. Furthermore, the assumption is made that provincial operating grants to universities will at least be maintained at the present level. It is also assumed that support from provincial and federal departments for university research will continue. Two examples of the latter are provincial support for agricultural research and free ship time provided by the federal government for oceanographic research.

On the basis of its findings (summarized in Table 12 at the beginning of this chapter), the Task Force concludes that there is an urgent need for further infrastructure support of $48 M for NSERC-sponsored research (Table 12). The Task Force believes that this is a conservative estimate of need for reasons that are given throughout this report.

How pressing is this need? Will meeting it lead to a greatly enhanced output of high quality research? The Task Force is firmly convinced that the answer to this latter question is yes. It was repeatedly reported that our best university researchers would be far more productive and, as a consequence, very much more competitive internationally, if they had the skilled technical manpower needed to ensure maximum use of sophisticated equipment which would be kept up-to-date and in an excellent state of repair. The Task Force is convinced that both the efficiency and effectiveness of university research would be greatly enhanced if some of the repetitive, yet highly sophisticated, laboratory procedures were to be carried out by skilled technical personnel who would provide continuity for research programs while assisting in the training of graduate students. Furthermore, the research enterprise would be strengthened if at least our major research-oriented universities were able to maintain the kind of support services relating to computation, electronics, instrumentation and the like that one finds in leading government and industrial research centres.

One question that should be raised in the context of a recommendation for a major infusion of new money into infrastructure support for NSERC-sponsored research is, why should the total funding requirement be met by NSERC? Should not the universities make some contribution from their provincially-derived operating budgets? Based on extensive consultations, the Task Force's response to this question is, **ideally yes, but in the present climate of university core funding, this is not a realistic approach to the problem.** All universities are hard-pressed to cover the overhead costs for the research sponsored by external agencies, let alone to increase their funding for research infrastructure. Indeed, the Task Force is concerned that it is not being very realistic in assuming that the present significant level of infrastructure support provided by the universities will be maintained. It follows then that if NSERC is to protect and build on its already very substantial investment in university research, it must be prepared to assume the full responsibility for the additional infrastructure funding needs.

A further question is whether the identified needs must be wholly met through new money or whether trade-offs are possible with existing programs. It is clear that operating grants at their current level cannot carry a larger share of infrastructure costs. Indeed, the increasing charges being assessed by

universities for support services (central and departmental) are already placing extraordinary pressure on grants. Nevertheless, the introduction of a new infrastructure program can be expected to permit a significantly slower growth in operating grants than might otherwise be the case.

Should equipment grants be reduced if necessary to provide funds for infrastructure? Some Task Force members are convinced that in many instances adequate infrastructure support for the existing equipment is more important than purchasing new equipment. Obviously, the Task Force hopes that such a trade-off will not be necessary because both needs are urgent.

Recommendation

It is recommended that increased funding of $48 M per annum be allocated to support the additional personnel and non-salary infrastructure needs identified in this report.

Chapter 8

MECHANISMS FOR IMPLEMENTATION OF AN EXPANDED INFRASTRUCTURE PROGRAM

For the purpose of examining possible mechanisms for the implementation of an expanded NSERC infrastructure program, it is convenient to group infrastructure needs into two main categories: (1) those related to major facilities of a specialized nature, and (2) other needs. The latter includes needs associated with facilities and services that are "standard in a discipline and present in many university departments".

Infrastructure Support for Major Facilities of a Specialized Nature

The present NSERC program of providing infrastructure support for major facilities based on peer evaluation of the excellence of the research program associated with the facility and of need appears to be functioning very satisfactorily. It is the Task Force's view that this program should be continued. Any alternative which does not involve periodic review, including site visits by experts, would clearly be unacceptable.

Included in this category are nuclear installations, field stations, marine facilities, regional facilities, major inter-departmental and inter-university research centres or institutes. Based on the most recent competition, these are expected to total approximately $7.6 M (see Chapter 9, page 51).

It would seem reasonable that awards in this category should be made by the Committee on Grants and Scholarships, based on recommendations from grant selection committees or, as appropriate, from **ad hoc** visiting committees. This is the mechanism currently used for most applications in the infrastructure II category and it appears to be operating quite satisfactorily.

Recommendations on the funding of nuclear installations are at present made by the Nuclear Sciences Grant Selection Committee following site visits by this Committee. There is no reason why this should not continue.

A special situation exists in Computer Science where a large number of infrastructure I grants (12, amounting to $0.8 M in 1984-85), are currently being made by the Computing and Information Sciences Grant Selection Committee. These usually cannot be classified as infrastructure support of "major facilities of a specialized nature" and, therefore, appropriately belong to the second category.

This is also the case for the so-called infrastructure II grants that are now awarded in association with new items of equipment. Unless the infrastructure requirement is large and the equipment is of a highly specialized nature, support should normally be provided under the second category. This does not preclude periodic site visits and peer review of facilities where warranted.

Infrastructure Support for Other Than Major Facilities of a Specialized Nature

A number of approaches were considered for the apportionment of infrastructure funds in support of facilities and services which do not belong in the first category. These facilities and services include many that are currently funded as infrastructure I grants, as well as those that are excluded from the current Program.

Applications vs Formula

The first question addressed by the Task Force in its deliberations on mechanisms was the relative merits of a program which is based on applications (by groups of researchers, departments, universities, etc.) with peer review, or which is based on a formula which relates infrastructure support to the level of research activity as determined by the total amount of NSERC grant funding.

There is much that is attractive in a program where all awards are based on applications. It would conform to NSERC's present grant practices in which the criterion of excellence is paramount, and it would provide NSERC with direct control with respect to the eligibility of different categories of expenditure. It is estimated that as many as one thousand new applications might be generated in such an expanded program.

On the other hand, large numbers of new applications would add greatly to the workload associated with NSERC's peer review system, which is already at the point of saturation. Furthermore, the Task Force, in its visits, detected a strong aversion by members of the research community to the additional paperwork that would be associated with yet another grants program based on applications. Also, by adding to the multiplicity of NSERC programs requiring applications, such a program would increase confusion concerning the eligibility of different classes of expenditure.

Finally, in dealing with infrastructure applications under such a program, review committees would have the difficult task of trying to come to grips with the relative needs of departments and would largely duplicate the evaluation of excellence already carried out in the operating grants program.

As an alternative to the introduction of a new infrastructure grants program based on the submissions of applications, one might increase the funds for operating grants and support central services through systems of user fees and/or levies. This approach suffers from the problem of instability of funding, the difficulty that GSCs have in making awards that reflect the actual costs of research, and the problem of accommodating the infrastructure needs of new young researchers. In addition, infrastructure support through operating grants has encouraged and would continue to encourage unnecessary duplication of personnel, poor maintenance of equipment and services and would tend to limit accessibility of services to others. Furthermore, technicians employed by a

Chapter 7

WHAT IS REQUIRED

The Task Force is convinced that there is an urgent and substantial need for additional infrastructure support for university research in Canada over and above that which is already funded through NSERC's current infrastructure grants program. This additional need is summarized in the following Table, the figures of which are an extrapolation to all Canadian universities of the needs identified at the nineteen universities surveyed in the questionnaire. As stated in Chapter 3, the latter represent 66% of total NSERC funding.

TABLE 12

Additional Infrastructure Needs Associated With NSERC Projects and Programs at Canadian Universities

Additional Infrastructure Needs	Number of Personnel	Cost/Year 1984 $	% Increase in cost over current level
1. Personnel - Departments 1023 people @ $28,000	1023	$28.6 M	72
2. Non-Salary - Departments		$12.6 M	74
3. Personnel - Central Services 173 people @ $28,000	165	$ 4.6 M	29
4. Non-Salary - Central Services		$ 2.1 M	16
5. Total Additional Needs	1188	$47.9 M	56

It is clear from the survey and the discussions with the universities that there exists a serious shortfall between the level of infrastructure support now being provided from all sources, and that which is required to ensure the efficient and effective utilization of research equipment and access to the highly skilled technical services required in most fields of research. Furthermore, the shortfall will grow both as a result of increased sophistication of research equipment in most disciplines and of the increasing intensity of university-based research in areas related to economic development.

The financial problems of the universities are now well known and, in most cases, there is no reason to expect a change for the better. Despite the best efforts of administration to support research, there is growing pressure to meet the immediate needs of teaching programs at the expense of research needs. The Task Force heard repeatedly during its visits that declining support for adequate research infrastructure in the universities presents an extremely serious obstacle to Canada playing an appropriate role in the international research network. The message received from researchers was both loud and clear: NSERC, in developing its second Five-Year Plan, must give the highest possible priority to programs designed to remedy this situation.

As stated in Chapter 4, support for the operation and maintenance of facilities standard in a discipline and present in many university departments is not adequately provided under existing NSERC programs; operating grants are inadequate and such facilities are not eligible for infrastructure grants. Equipment is not being adequately maintained at present and all too often it is not being operated at maximum efficiency and effectiveness simply because no one person or group has the responsibility, the knowledge and resources to ensure this level of service.

Too often, graduate students are required to operate sophisticated state-of-the-art equipment without adequate training and supervision by persons having the necessary technical expertise. Service contracts are not routinely purchased or have been dropped and are not being replaced by proper preventive internal maintenance programs. Also, the Task Force found many instances where the operation of some of the most advanced and highly specialized research equipment requires PhD level personnel. These people are not affordable with current funding.

In many instances, equipment is not being upgraded because of the lack of funds. The Task Force is very concerned that requests for new equipment may have increased partly as a result of a lack of proper maintenance and upgrading. There is clearly a perception in the research community that NSERC funding has been easier to obtain for the replacement of equipment than for the upgrading of existing facilities. The Task Force is, in fact, concerned that some of the pressure for new equipment has resulted from a lack of funds for maintenance and upgrading of existing equipment.

There is an increasing need at all Canadian institutions for computing infrastructure personnel, including advisors for the central facilities and software specialists at the departmental level who are familiar with the particular discipline. This need must be met if the competitiveness of Canada's research community is to be maintained and if that community is to respond to new opportunities.

It is important to recognize that the new infrastructure needs summarized at the beginning of this Chapter do not take into consideration the growth that will inevitably take place in the direct funding of research by both levels of government, nor the growth in industry-university contract

The question arises whether, in calculating the base, adjustments should be made by subtracting the operating grants of individuals whose research is associated with a major facility which is already supported by an infrastructure grant. It can be argued that not doing so would, in effect, be giving the department and the university double credit. On the other hand, doing so would cause problems, especially in calculating the appropriate fraction of the faculty member's grant which should be subtracted from the departmental base when only a part of the researcher's work is associated with the major facility. It is the view of the Task Force that while adjustments may be appropriate in certain cases, in general, infrastructure grants for major facilities should be ignored in calculating both the departmental and university block grants. This matter, however, may warrant closer examination.

The Task Force also suggests that, in the interests of minimizing administrative costs, a threshold be established for the departmental funding base. Infrastructure funds generated below this threshold would go to the university rather than to the department. The threshold might be in the area of $50,000, which, on the basis of the proposed infrastructure funding formula (see Chapter 9), would generate about $15,000.

Expenditure Guidelines and Accountability

In establishing a new infrastructure grants program, Council should provide clear guidelines on the categories of expenditures which are eligible for support. These should be patterned after the definitions set out in this report. It will be especially important, for example, to ensure that funds are not used for expenditures which are specific to the research of an individual grantee and which should be funded from an operating grant.

While considerable flexibility should be allowed in the allocation of the university infrastructure block grants, it is expected that the greater part of such grants will be distributed to groups of researchers and to departments. While some portion of the block grant to the university will be used to support central services, it clearly is not the purpose of the program to relieve universities of their current funding responsibilities for such services.

One of the important uses of the university grant should be to supplement departmental infrastructure grants where needs are especially high in relation to levels of operating grants. A particular example of this is the field of Computer and Information Science for which substantial amounts are now being awarded by the grant selection committee under the present infrastructure I grants program. This would indicate that a substantial allocation from the university infrastructure block grant will be required in this discipline in most institutions, since the allocation at the departmental level will probably be lower than the amount currently awarded through infrastructure I grants.

An annual report should be submitted to NSERC by each department and university receiving an infrastructure grant. This report should not only provide information on how NSERC infrastructure funds have been spent, but should indicate the level of support provided from non-NSERC sources, including the university. Parts of the questionnaires used in the present study might be suitable for this latter purpose.

The universities should review each departmental report to assure completeness and accuracy before forwarding it to NSERC. Council staff should carefully monitor all reports and be prepared to raise questions at the appropriate level when problems arise. In certain cases, it may be necessary to withhold funding for the subsequent year until problems have been resolved.

It is a concern of the Task Force that NSERC should be used in ways that are in accord with the objectives of the program and that the researchers themselves are in general satisfied that their research programs are receiving appropriate infrastructure support commensurate with funds available. Many universities, in dispensing the general research grants, have established research boards comprised of active researchers. Many of these are operating very effectively indeed and they would appear to be suitable models for the allocation of infrastructure funds at the university level. NSERC should be prepared to assist universities in developing effective mechanisms for this function.

At the departmental level, allocation decisions should be made through an appropriate mechanism which assures full consultation with active researchers. Every effort should be made to ensure that younger researchers are provided with adequate infrastructure support.

Recommendations

Infrastructure grants in support of major facilities of a specialized nature should be made on the basis of applications and peer review. Existing procedures appear to be adequate and should be continued.

Other NSERC infrastructure support, including the support of facilities and services that are standard in a discipline, should be made in the form of block grants, with 50% of the funding being allocated to the university and 50% to departments.

Departmental infrastructure block grants should be based on the total individual and team operating grants, strategic grants, PRAI grants and other project grants, as well as six-year average of regular equipment, major equipment and strategic grants received by department members; university infrastructure block grants should be determined by the total amount of the above-named grants for the whole university.

Council should establish clear guidelines for eligible categories of expenditures and allocation procedures for infrastructure block grants, and should require annual reports from each unit receiving such grants.

Chapter 9

FUNDING IMPLICATION OF TASK FORCE'S PROPOSALS

Total Funding Level Required for the Proposed Infrastructure Grants Program

If Council were to recommend and gain financial approval for a program of infrastructure block grants, part of the present infrastructure budget would have to be transferred to the new program, as most present infrastructure I grants and some of the infrastructure II grants would not meet the proposed application criterion of being a major specialized facility.

The present infrastructure grant program has a total budget of $12.7 M. Of this, $7.6 M will be required under the new program to fund applications for major specialized facilities. (The $7.6 M is calculated as follows: $3.2 M from the current $4 M budget for infrastructure II grants to fund those grants which should be retained in a program for which applications are reviewed by NSERC, and $4.4 M from the current $8.7 M budget for infrastructure I grants to fund nuclear accelerators ($4M) and some specialized facilities ($.4M) (telescopes, Canadian synchrotron radiation facility, field stations)). Of the remaining $5.1 M, $1.1 M would be returned to the GSCs as this is the amount they presently contribute from their budgets toward the type I infrastructure grants. The balance of $4.0 M from the present infrastructure grants budget would remain to be transferred to the block funding component of the new program to support the costs of infrastructure services presently being funded by NSERC.

The budget required for the block grant component of the new program is $48 M (the additional needs identified in the present study, page 40), plus $4 M (the amount to be transfered to support the costs of infrastructure services which would not be eligible for the application program but which are presently funded by NSERC), i.e. $52 M.

This total budget of $52 M would be distributed to universities on the basis of their NSERC grant funding base which would include individual and team operating grants, strategic grants, PRAI grants, and other project grants, as well as a six-year average of regular equipment, major equipment and strategic equipment grants.

The sum total of this base for 1983-84 (the last year for which all figures are available) is $177 M. This results in a proportionality factor of approximately 0.30 for distributing the block grant funds to the universities:

$$\frac{52}{177} = 0.294$$

In summary, the total budget of the proposed infrastructure grants program would be $59.6 M composed of $7.6 M to support major facilities of a specialized nature through application and peer review and $52 M in the form of block grants to departments and universities. Of this total, $48 M would be over and above present funding levels.

Funding Implications by Individual University

Using the proportionality factor of 0.30 developed in the previous Section, it is possible to calculate for each individual university the total block grant funding under the proposed new program. This is shown in Table 13, column 3.

To calculate the net new funding for each institution under this program (column 4), it is necessary to subtract the existing infrastructure grants which would be transferred to the new program. Since most of the latter are of the infrastructure I type, the figures in column 2 have been used for this subtraction.

Overall, it was found through the questionnaires that approximately 85 percent of the new funding required is for support of facilities and services at the departmental level and 15 percent at the university level (central services). While the division between departmental and central requirements will vary from institution to institution, it is convenient to use this ratio in arriving at the projected increases for departmental facilities and services shown in Table 13, column 5.

It has also been found through the questionnaires that, overall, 70 percent of the additional departmental requirements is in support of personnel and 30 percent is for non-salary costs. The figures of column 6, increased funding for departmental personnel, therefore, are 70 percent of the figures of column 5. The number of additional personnel (column 7) have been calculated by dividing the figures of column 6 by $28,000, the average cost of salaries and benefits for existing technical and professional support staff in the universities. The Task Force believes that this figure is realistic bearing in mind that a larger proportion of new personnel will be at the professional scientist and engineer level than at present because of growing sophistication of equipment and other service needs.

Finally, the projected increase in non-salary support at the departmental level is given in the last column of the Table using the overall figure of 30 percent of total additional departmental requirements.

No attempt has been made to apportion the central service requirements (15 percent of column 3) between salary and non-salary costs because the application of an overall ratio to each institution would be quite meaningless. The nature of central services simply varies too much from institution to institution.

It is possible to convert the figures given in Table 13 for infrastructure block grant funding levels to figures based on a proportionality factor other than the 0.30 of the grants base recommended by the Task Force. For example, if a 0.15 proportionality factor were to be used, all figures in columns 3-8 would be one-half those shown.

TABLE 13

Projected Block Grants by University

	1983-84 Base 000$	1983-84 Infra I 000$	Total Projected Block Grant Funding 000$	Net New Block Grant Funding 000$	Projected Increase For Departmental Services 000$	Increase in Departmental Personnel 000$	Increase in Departmental Personnel Number	Increase in Departmental Non Salary Support 000$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
U.B.C.	16,090	566	4,827	4,261	3,622	2,535	91	1,087
Simon Fraser	3,471	99	1,041	942	801	561	20	240
Victoria	2,818	107	845	738	627	439	16	188
BRITISH COLUMBIA	22,379	772	6,713	5,941	5,050	3,535	127	1,515
Alberta	11,588	849	3,476	2,627	2,233	1,563	56	669
Calgary	6,268	98	1,880	1,782	1,515	1,060	38	454
Lethbridge	297	0	89	89	77	54	2	23
Saskatchewan	5,826	144	1,749	1,605	1,364	955	34	492
Regina	502	0	151	151	128	90	3	38
Manitoba	6,205	113	1,863	1,750	1,488	1,041	37	446
Brandon	68	0	21	21	18	13	.5	5
Winnipeg	169	0	51	51	44	31	1	13
PRAIRIES	30,923	1,204	9,280	8,076	6,867	4,807	171.5	2,140
Brock	752	0	226	226	192	134	5	58
Carleton	4,005	96	1,202	1,106	940	658	24	282
Guelph	7,951	97	2,385	2,288	1,945	1,362	49	583
Lakehead	631	0	189	189	161	112	4	48
Laurentian	630	0	189	189	161	112	4	48
McMaster	8,221	216	2,466	2,250	1,913	1,339	48	339
Ottawa	4,406	95	1,322	1,228	1,044	731	26	313
Queen's	6,568	313	1,970	1,467	1,247	873	31	374
Toronto	21,052	716	6,316	5,599	4,759	3,331	119	1,427
Trent	296	0	89	89	76	53	2	23
Waterloo	11,243	300	3,373	3,073	2,612	1,828	65	784
Wilfrid Laurier	159	0	48	48	41	29	1	12
Western	6,171	243	1,851	1,608	1,367	957	34	410
Windsor	2,423	41	729	688	585	410	15	175
York	3,191	76	957	881	749	524	19	225
ONTARIO	77,699	2,193	23,312	20,929	17,792	12,453	446	5,101

TABLE 13 (continued)

	1983-84 Base 000$	1983-84 Infra I 000$	Total Projected Block Grant Funding 000$	Net New Block Grant Funding 000$	Projected Increase For Departmental Services 000$	Increase in Departmental Personnel 000$	Number	Increase in Departmental Non Salary Support 000$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bishops	25	0	7	-	-	-	-	-
Laval	5,405	142	1,622	1,481	1,259	881	32	378
McGill	10,103	305	3,031	2,725	2,316	1,621	60	695
Montreal	5,131	314	1,539	1,225	1,041	729	26	312
École Polytech.	3,252	121	976	854	726	508	18	217
Sherbrooke	2,493	108	748	639	543	380	14	163
Concordia	3,166	102	950	848	721	505	18	216
U.Q.A.M.	506	45	152	107	91	64	2	27
U.Q.A.C.	429	15	129	114	97	68	2	29
U.Q.T.R.	899	0	270	270	230	161	6	69
U.Q.A.R.	116	0	35	35	30	21	1	9
I.N.R.S.	1,356	33	407	374	318	223	8	95
I.A.F.	310	0	93	93	79	55	2	24
QUEBEC	33,191	1,185	9,959	8,765	7,451	5,216	189	2,234
Moncton	167	0	50	50	43	30	1	13
Mount Allison	260	0	78	78	66	46	2	20
U.N.B.	3,176	181	953	773	657	460	16	197
St. Thomas	6	0	2	2	2	-	-	2
Acadia	333	0	100	100	85	60	2	25
Dalhousie	4,289	123	1,287	1,164	989	693	25	297
Mt. St. Vincent	52	0	16	16	14	10	.5	4
T.U.N.S.	808	0	243	243	207	145	5	62
St. Francis Xavier	346	0	105	105	89	62	2	27
St. Mary's	181	19	54	35	30	21	1	9
N.S.A.C.	57	0	17	17	15	13	.5	2
Cape Breton	21	0	6	6	15	13	.5	2
P.E.I.	55	0	17	17	17	14	.5	3
Memorial	3,304	107	991	883	751	525	19	225
ATLANTIC PROVINCES	13,055	430	3,919	3,489	2,980	2,092	75	888

The Task Force would like to reiterate, however, that the 0.30 proportionality factor has been developed on the basis of needs clearly identified in the questionnaires and visits, needs which in its judgement are fully justified and in all probability have been underestimated.

It should be borne in mind that although 85 percent of the new funding is required for the support of facilities and services at the departmental level, as distinct from the support of central services, the proposed block funding program provides for a 50:50 division between departments and the university. It follows that on average one would expect that approximately two-thirds of the university block grant would be reallocated to departments or other research units in relation to priorities and needs.

Funding Implications by Region

Table 13, in addition to providing funding data by individual university, also provides data by region. It is important to recognize that these totals are simply a reflection of the total level of NSERC-funded research activity by region as measured by operating grants, strategic grants, equipment grants, etc., all of which impose an infrastructure requirement on the universities.

Any unevenness in the regional distribution of NSERC's funding base in relation to population is primarily a consequence of the relative numbers of faculty researchers by region. This cannot be corrected through an infrastructure program of the type proposed in this Report.

Implications by Discipline

Table 14 shows a percentage breakdown by discipline of the NSERC funding base of $177 M and of the infrastructure **departmental** block grants derived from that base amounting to $26 M. An equivalent amount would be received by the university based on the 50:50 division between the two levels. As stated earlier, a major fraction of the university block grant can be expected to be reallocated to departments. It is impossible, however, to estimate the discipline distribution of the latter since its major purpose is to provide universities with the flexibility required to respond to special needs.

TABLE 14

New Program Funding by Discipline

	% of 1983-84 Base*	Anticipated Infrastructure Block Funding to Depts ($ M)
Biology	28.5	6.8
Chemistry	13.6	3.3
Physics	16.8	4.0
Engineering	24.7	5.9
Earth Sciences	7.9	1.9
Math. & Stats. Comp. Science	8.6	2.1

* From data generated by NSERC Planning and Budgeting Directorate.

Recommendation

Based on current levels of NSERC-sponsored research activity, $7.6 M per year should be allocated to infrastructure grants in support of major facilties of a specialized nature and $52 M per year to infrastructure block grants to departments and universities. Included in the latter is new funding of $48 M per year, the need for which has been documented in this report.

BIBLIOGRAPHY

R&D Expenditures in Canada, Statistics Canada, May 1983 and 1984 update.

1984-85 Awards Guide, NSERC.

Canadian Science Indicators 1983, Statistics Canada.

Interprovincial Comparisons of University Financing, Fifth Report of the Tripartite Committee on Interprovincial Comparisons, January 1984.

Comparative Study of Animal Care Charges in Canada, 1981, Canadian Council of Animal Care.

Financial Statistics of Universities and Colleges, 1982 and 1983, Report 22D, Statistics Canada.

Appendix A

NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL
Task Force on Research Infrastructure
Membership

Chairman:

Dr. W. Winegard
R.R. No. 1
Georgetown, Ontario
L7G 4S4

Co-Chairman:

Dr. A.N. Bourns
Visiting Research Officer
Natural Sciences and Engineering
Research Council
Ottawa, Ontario
K1A 1H5

Members:

Dr A. Caillé
Directeur
Département de physique
Faculté des sciences
Université de Sherbrooke
Sherbrooke (Québec)
J1K 2R1

Dr. J.J. MacDonald
Executive Vice-President
St-Francis Xavier University
Nicholson Hall, Room 8
Antigonish, Nova Scotia
B2G 1C0

Dr. N. Morgenstern
Department of Civil Engineering
University of Alberta
Edmonton, Alberta
T6G 2E1

Dr. J.E. Phillips
Department of Zoology
University of British Columbia
Vancouver, British Columbia
V6T 1W5

Dr. J. Wright
Manager
Materials Processing Laboratory
Xerox Research Centre
2660 Speakman Drive
Mississauga, Ontario
L5K 2L1

Secretary:

M.L. McArthur
Strategic Grants Officer
Natural Sciences and Engineering
Research Council
Ottawa, Ontario
K1A 1H5

Appendix B

The following universities have been selected to receive the questionnaire on the costs of research infrastructure support.

University of British Columbia
University of Victoria
University of Alberta
University of Calgary
University of Saskatchewan
University of Manitoba
Lakehead University
McMaster University
University of Toronto
Université d'Ottawa
McGill University
École Polytechnique
Université Laval
Université de Sherbrooke
University of New Brunswick
Memorial University
Dalhousie University
St-Francis Xavier University
Technical University of Nova Scotia

Appendix C

NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL

TASK FORCE ON RESEARCH INFRASTRUCTURE

A QUESTIONNAIRE

(To be completed by heads of departments and/or interdepartmental research units)

INTRODUCTION

In the context of developing its second Five Year Plan, the Natural Sciences and Engineering Research Council of Canada (NSERC) has established a Task Force on Research Infrastructure. The terms of reference of the Task Force are attached. This questionnaire is one component of an investigation with respect to the first term of reference, which is "To review the present state of the infrastructure for research in the natural sciences and engineering in Canadian universities, including specifically the maintenance and operation of equipment and the provision of technical services, but excluding faculty manpower resources." Your cooperation in this endeavour is requested.

Please note that the work of this Task Force is NOT linked to the evaluation of future grant requests. Council is attempting to estimate the aggregate research infrastructure needs of Canadian universities in the natural sciences and engineering, and the extent to which these needs are not being met by current funding sources. This information will be useful to Council as it establishes its priorities for the next five years.

WHO SHOULD ANSWER THIS QUESTIONNAIRE

The purpose of this questionnaire is to elicit complete information without omissions or duplication on infrastructure facilities and services at selected universities in order that NSERC's five year plan can present the current situation as accurately as possible. The questionnaire should normally be completed by heads of departments and major interdepartmental research units in which several faculty members hold NSERC grants. However, for facilities such as machine shops, greenhouses, etc., which serve, a research community broader than a single department or major research unit on a regular basis, a questionnaire will be completed by a central source. at your university has attended a meeting concerning this questionnaire and is familiar with the terms of reference and definitions associated with it. He will serve in a liaison capacity for the study and will ensure that responses from your university are complete.

DEFINITIONS

Research costs can be divided into three categories, each of which is defined below.

Traditional Direct Costs - Costs which would normally be funded by NSERC grants. These include:

- graduate student stipends,
- salaries of research assistants or associates, either technical or professional, whose work is primarily associated with a single grantee,
- materials and supplies including the purchase of living materials for specific projects and the cost of maintenance of living materials after their purchase by researchers,
- capital costs of equipment and major installations,
- machine, electronic, glassblowing, and computing services related to specific projects, (for example, the hourly charge for the construction of a piece of equipment and the charges associated with using a shared computing resource).

Traditional Indirect Costs - Costs associated with the provision of light, heat, water, laboratory space, storeroom services, secretarial support and other administrative services. Also included are the capital and overhead costs associated with the operation of machine shops, animal quarters, greenhouses, etc.

Infrastructure Costs - The Task Force recognizes that the lines of demarcation between direct, indirect and infrastructure costs are blurred. For the purposes of this questionnaire, infrastructure costs are considered to be the costs associated with (i) the maintenance and operation of specialized research equipment and (ii) the provision of technical support services which are used in common by a number of faculty researchers and their associates.

For the purposes of this questionnaire only, infrastructure costs DO NOT include (a) the salary and fringe benefit costs for faculty, (b) the salary and fringe benefit costs for support personnel required to maintain a facility for the purpose of undergraduate teaching, and (c) the salary and fringe benefit costs for support staff who are working on the research programs of an individual researcher or a single research group. (These costs would normally be charged to the grants or contracts supporting these programs.)

To provide further clarification of the definition of infrastructure costs used in this questionnaire, such costs have been divided into the following four broad categories.

1. Salary costs associated with equipment

The salary and fringe benefit costs of personnel dedicated to the operation and maintenance of specialized equipment

This category includes highly skilled technicians who operate such items of equipment as electron microscopes, x-ray diffraction units, NMR spectrometers, shared computers for specialized research projects, amino-acid analyzers, etc., regardless of whether this equipment has become relatively standard in certain disciplines. Such apparatus often requires the skills of an experienced operator for maximum efficiency and/or capability and is used in common by a number of faculty researchers.

Also included are professionals who provide expert management for, and the technical support staff associated with, a major installation or regional facility; for example, the NMR regional facilities at the University of Guelph and Dalhousie University.

2. Salary costs associated with technical services

The salary and fringe benefit costs of personnel who provide highly skilled technical or professional services not necessarily related to a particular piece of equipment

This category includes personnel associated with such activities as materials preparation, software and hardware maintenance of shared research computing facilities, tissue culture services, DNA sequencing, analytical services, general support for field studies, etc. These should be services used in common by several research groups rather than services associated with the program of an individual researcher or a single research group.

3. Salary costs associated with service facilities

The salary and fringe benefit costs of personnel associated with research service facilities (shops, greenhouses, growth chambers, animal care facilities, etc.)

When such facilities as those listed above are used to support research, incremental costs accrue, which are over and above the costs associated with a basic facility providing support for undergraduate teaching. For the purposes of this questionnaire, only these incremental costs are considered as research infrastructure costs. Included in this category are the costs of research advisory services provided by the facility (for example, advice on the design and construction of complex apparatus). Also included are advisory services on the choice of a computer hardware and/or software configuration and the selection and maintenance of mini-computers and their interfacing with other apparatus.

4. Non-salary costs

The costs of equipment maintenance (service contracts, replacement parts, minor upgrading, etc.)

Examples of the above are the costs of x-ray diffraction targets, laser tubes, standard vendor computer maintenance contracts, replacement parts and minor upgrading of specialized research equipment found in animal care facilities, greenhouses and environmental chambers, etc. These costs are appropriately designated as infrastructure costs only when the equipment is used in common to support the research of several research groups. Note: If the equipment is only used to support the research of an individual researcher or a single research group, maintenance costs would normally be charged to the grants or contracts which support the research.

INSTRUCTIONS

Please complete the questions that are applicable to your department or research unit. In certain instances, only approximate numbers can be provided. All dollar figures should be rounded to the nearest one hundred or one thousand dollars as appropriate. When a particular service or facility, especially those under category 3 on page 3 (shops, greenhouses, etc.), serves a research community broader than the members of your department or unit on a regular basis, DO NOT include its technical personnel in your response because the heads of such facilities will also be completing questionnaires. This exclusion should be noted in your response, however. In case of doubt, consult with the person named on the front page of this document.

In estimating infrastructure needs, DO NOT include the costs of technical personnel who would simply take over what graduate students are now doing as part of their research training; however, DO include the costs for those persons who would be helping and advising graduate students. While it may be more efficient to have the operation of every complex piece of equipment or difficult laboratory procedure carried out by experienced technicians, the quality of training will suffer seriously if graduate students are denied the opportunity to operate apparatus themselves.

GLOSSARY OF TERMS

1. FTE - full time equivalent.

2. Research Associate - Persons who have experience beyond the postdoctoral level and who are doing research either independently or in association with a faculty member.

3. Technical or professional support staff - persons who perform a <u>support</u> function for research because of their technical or professional expertise.

4. Research group - an individual professor and his/her students and research associates; also two or three faculty members working on the same project (for example, faculty members holding a team operating grant would fit into this category.)

SECTION A

GENERAL INFORMATION

1.1 Name of University _____

1.2 Name of Reporting Unit (e.g. department, faculty, institute, specialized facility, etc.)

_____

1.3 Name of person completing this questionnaire

_____

1.4 Total sponsored research funding (grants and contracts) received by the unit in 1983-84 (April 1, 1983 to March 31, 1984 or the university's fiscal year whichever is more convenient) _____

1.5 Total NSERC funding received by the unit in 1983-84 _____

Number of personnel in the unit in 1983-84

2.1 Faculty (active in research and eligible for NSERC grants) _____

2.2 Research degree graduate students (full-time equivalent (FTE)) _____

2.3 Course degree graduate students (FTE) _____

2.4 Postdoctoral Fellows and Research Associates (FTE) _____

2.5 Total technical or professional support staff (FTE) working on all research in the unit. _____

2.6 Of the totals given in question 2.5 give the number of technical or professional support staff (FTE) providing infrastructure support services for the unit in 1983-84 _____

SECTION B

This section requests information on the number (FTE) and costs of personnel providing infrastructure support services for the unit's research in fiscal year 1983-84, i.e. the total reported in question 2.6.

		No.(FTE)	Costs $
3.1	Total infrastructure staff WORKING on projects/programs which are largely* supported from NSERC grants	_____	_____
	Of the total in 3.1 indicate those persons:		
3.2	PAID from NSERC grants	_____	_____
3.3	PAID from University funds	_____	_____
3.4	PAID from other sources	_____	_____
4.1	Total infrastructure support staff WORKING on projects/programs which are largely* supported from sources other than NSERC grants	_____	_____
	Of the total in 4.1 indicate those persons:		
4.2	PAID from NSERC funds	_____	_____
4.3	PAID from University funds	_____	_____
4.4	PAID from other sources	_____	_____

* Normally these would be projects/programs for which at least 50% of the funding comes from NSERC grants. A smaller percentage may be appropriate when the NSERC contribution is large, i.e. 50k or more.

SECTION C

This section requests information on the number (FTE), costs and type of personnel the unit NEEDS to provide infrastructure support for projects/ programs which are largely supported from NSERC grants.

5.1 Total infrastructure support staff (present staff plus additional staff) NEEDED for projects/programs largely supported from NSERC grants

	No.(FTE)	Costs $
	_____	_____

If the number of staff (FTE) NEEDED in question 5.1 is larger than the figure given in question 3.1 of Section B (the total infrastructure support staff presently WORKING on projects/programs largely supported from NSERC grants) indicate with the appropriate number (FTE) the ADDITIONAL personnel required for:

6.1 Operation and maintenance of specialized equipment and computer software _____

6.2 Skilled technical and professional services not associated with specialized equipment _____

6.3 Research service facilities including advisory services _____

6.4 Other (specify) _____

You may wish to include comments in SECTION G on possible sources of funding and trends in regard to the additional personnel required to provide infrastructure support for projects/programs largely supported from NSERC grants.

SECTION D

In order to illustrate recent trends in your research unit, give the number of support staff (FTE) working as infrastructure support for projects/programs largely supported from NSERC grants for the past two fiscal years.

		No. FTE	Costs $
7.1	Total Infrastructure staff WORKING on projects/programs which were largely supported from NSERC grants in 1982-83	_____	_____
	Of the total in 7.1 indicate those persons:		
7.2	Paid from NSERC grants	_____	_____
7.3	Paid from university funds	_____	_____
7.4	Paid from other sources	_____	_____
8.1	Total Infrastructure staff WORKING on projects/programs which were largely supported from NSERC grants in 1981-82	_____	_____
	Of the total in 8.1 indicate those persons:		
8.2	Paid from NSERC funds	_____	_____
8.3	Paid from university funds	_____	_____
8.4	Paid from other sources	_____	_____

SECTION E

This section requests information on non-salary infrastructure costs and needs for NSERC projects or programs. These costs include the cost of replacement parts, upgrading and service contracts for equipment being used for projects or programs largely supported from NSERC grants, regardless of the source of funds from which the equipment was purchased.

Approximate non-salary infrastructure costs in fiscal year 1983-84 and sources of funding.

	Source of funds: NSERC $	University $	Other $
9.1 Replacement parts and minor upgrading for equipment	_____	_____	_____
9.2 Service contracts	_____	_____	_____
9.3 Other non-salary infrastructure costs (explain in SECTION G)	_____	_____	_____

You may wish to make comments in SECTION G on recent trends in funding from these sources.

Estimate ADDITIONAL yearly non-salary infrastructure expenditures NEEDED to support NSERC projects in the unit

	$
10.1 Replacement parts and minor upgrading for equipment	_____
10.2 Service contracts	_____
10.3 Other non-salary infrastructure costs (explain in SECTION G)	_____

You may wish to make comments in SECTION G on possible sources of funding for these costs.

SECTION F

Research infrastructure has been defined, for the purposes of this questionnaire, in terms of support facilities and services used by more than one researcher or a single research group. A consequence of restricting NSERC's Infrastructure Grants to the support of services used in common by several research groups is that the individual researcher or a single research group (frequently in small universities) might find it necessary to fund from an Operating Grant, services that otherwise might be supported by an Infrastructure Grant. This anomally might be addressed by either broadening the definition of infrastructure, or by awarding operating grants that better reflect the varied costs of the research of grantees. This section seeks information on this issue.

11.1 Give the total number (FTE) and costs of support staff providing services of the kind encompassed by the term Infrastructure in this questionnaire BUT related to the NSERC sponsored research of an individual researcher or a single research group rather than of a number of research groups.

No.(FTE)	Costs $
_____	_____

12.1 Give the total number of ADDITIONAL support staff and costs NEEDED with respect to question 11.1.

No.(FTE)	Costs $
_____	_____

13.1 Give the total non-salary infrastructure costs associated with services of the kind encompassed by the term Infrastructure in this questionnaire BUT related to the NSERC sponsored research of an individual researcher or a single research group rather than of a number of research groups.

14.1 Give the ADDITIONAL non-salary infrastructure expenditures NEEDED with respect to question 13.1.

Costs $
_____

SECTION G

The Task Force would appreciate any comments you might have on the overall infrastructure funding issue. We would especially appreciate your comments in relation to SECTIONS C, E and F.

NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL

TASK FORCE ON RESEARCH INFRASTRUCTURE

A QUESTIONNAIRE

(To be completed by heads of central service facilities supporting science and/or engineering faculties)

INTRODUCTION

In the context of developing its second Five Year Plan, the Natural Sciences and Engineering Research Council of Canada (NSERC) has established a Task Force on Research Infrastructure. The terms of reference of the Task Force are attached. This questionnaire is one component of an investigation with respect to the first term of reference, which is "To review the present state of the infrastructure for research in the natural sciences and engineering in Canadian universities, including specifically the maintenance and operation of equipment and the provision of technical services, but excluding faculty manpower resources." Your cooperation in this endeavour is requested.

Please note that the work of this Task Force is NOT linked to the evaluation of future grant requests. Council is attempting to estimate the aggregate research infrastructure needs of Canadian universities in the natural sciences and engineering, and the extent to which these needs are not being met by current funding sources. This information will be useful to Council as it establishes its priorities for the next five years.

WHO SHOULD ANSWER THIS QUESTIONNAIRE

The purpose of this questionnaire is to elicit complete information without omissions or duplication on infrastructure facilities and services at selected universities in order that NSERC's five year plan can present the current situation as accurately as possible. The questionnaire should normally be completed by heads of departments and major interdepartmental research units in which several faculty members hold NSERC grants. However, for facilities such as machine shops, greenhouses, etc., which serve, a research community broader than a single department or major research unit on a regular basis, a questionnaire will be completed by a central source. at your university has attended a meeting concerning this questionnaire and is familiar with the terms of reference and definitions associated with it. He will serve in a liaison capacity for the study and will ensure that responses from your university are complete.

DEFINITIONS

Research costs can be divided into three categories, each of which is defined below.

Traditional Direct Costs - Costs which would normally be funded by NSERC grants. These include:

- graduate student stipends,
- salaries of research assistants or associates, either technical or professional, whose work is primarily associated with a single grantee,
- materials and supplies including the purchase of living materials for specific projects and the cost of maintenance of living materials after their purchase by researchers,
- capital costs of equipment and major installations,
- machine, electronic, glassblowing, and computing services related to specific projects, (for example, the hourly charge for the construction of a piece of equipment and the charges associated with using a shared computing resource).

Traditional Indirect Costs - Costs associated with the provision of light, heat, water, laboratory space, storeroom services, secretarial support and other administrative services. Also included are the capital and overhead costs associated with the operation of machine shops, animal quarters, greenhouses, etc.

Infrastructure Costs - The Task Force recognizes that the lines of demarcation between direct, indirect and infrastructure costs are blurred. For the purposes of this questionnaire, infrastructure costs are considered to be the costs associated with (i) the maintenance and operation of specialized research equipment and (ii) the provision of technical support services which are used in common by a number of faculty researchers and their associates.

For the purposes of this questionnaire only, infrastructure costs DO NOT include (a) the salary and fringe benefit costs for faculty, (b) the salary and fringe benefit costs for support personnel required to maintain a facility for the purpose of undergraduate teaching, and (c) the salary and fringe benefit costs for support staff who are working on the research programs of an individual researcher or a single research group. (These costs would normally be charged to the grants or contracts supporting these programs.)

To provide further clarification of the definition of infrastructure costs used in this questionnaire, such costs have been divided into the following four broad categories.

1. Salary costs associated with equipment

The salary and fringe benefit costs of personnel dedicated to the operation and maintenance of specialized equipment

This category includes highly skilled technicians who operate such items of equipment as electron microscopes, x-ray diffraction units, NMR spectrometers, shared computers for specialized research projects, amino-acid analyzers, etc., regardless of whether this equipment has become relatively standard in certain disciplines. Such apparatus often requires the skills of an experienced operator for maximum efficiency and/or capability and is used in common by a number of faculty researchers.

Also included are professionals who provide expert management for, and the technical support staff associated with, a major installation or regional facility; for example, the NMR regional facilities at the University of Guelph and Dalhousie University.

2. Salary costs associated with technical services

The salary and fringe benefit costs of personnel who provide highly skilled technical or professional services not necessarily related to a particular piece of equipment

This category includes personnel associated with such activities as materials preparation, software and hardware maintenance of shared research computing facilities, tissue culture services, DNA sequencing, analytical services, general support for field studies, etc. These should be services used in common by several research groups rather than services associated with the program of an individual researcher or a single research group.

3. Salary costs associated with service facilities

The salary and fringe benefit costs of personnel associated with research service facilities (shops, greenhouses, growth chambers, animal care facilities, etc.)

When such facilities as those listed above are used to support research, incremental costs, which are over and above the costs associated with a basic facility providing support for undergraduate teaching, accrue. For the purposes of this questionnaire, only these incremental costs are considered as research infrastructure costs. Included in this category are the costs of research advisory services provided by the facility (for example, advice on the design and construction of complex apparatus). Also included are advisory services on the choice of a computer hardware and/or software configuration and the selection and maintenance of mini-computers and their interfacing with other apparatus.

4. Non-salary costs

The costs of equipment maintenance (service contracts, replacement parts, minor upgrading, etc.)

Examples of the above are the costs of x-ray diffraction targets, laser tubes, standard vendor computer maintenance contracts, replacement parts and minor upgrading of specialized research equipment found in animal care facilities, greenhouses and environmental chambers, etc. These costs are appropriately designated as infrastructure costs only when the equipment is used in common to support the research of several research groups. Note: If the equipment is only used to support the research of an individual researcher or a single research group, maintenance costs would normally be charged to the grants or contracts which support the research.

INSTRUCTIONS

Please complete the questions that are applicable to your service facility. A more detailed questionnaire is being completed by departments and major research units (institutes) with the instruction that when a particular service facility, especially those in category 3, page 3 (shops, geeenhouses, animal quarters, central computer facilities, etc.), serves a research community broader than a single department or major research unit, the head of that facility rather than the head of the department or research unit will be providing the relevant data. In case of doubt, as to the data you should be reporting, please consult with the person named on the front page of this document.

In certain cases approximate numbers only can be provided. All dollar figures should be rounded to the nearest one hundred or one thousand dollars as appropriate.

SECTION A

GENERAL INFORMATION

1.1 Name of the University _____

1.2 Name of Reporting Unit (e.g. central machine shop, university animal quarters, computer centre, etc.)

_____

1.3 Name of person completing this questionnaire

_____

1.4 Total staff (FTE) employed in your service unit and serving both the teaching and research needs of the university _____

SECTION B

This section requests information on the number and costs of personnel in your service unit providing infrastructure support services for ALL research activities in the natural sciences and engineering in your university. (Only a portion of those counted in question 1.4).

	No.(FTE)	Costs $
2.1 Total staff (FTE) providing infrastructure support services for all research activities in natural sciences and engineering	_____	_____
Of the total in 2.1 indicate those persons:		
2.2 PAID from NSERC funds	_____	_____
2.3 PAID from University funds	_____	_____
2.4 PAID from other sources	_____	_____

Of the total paid from university funds (2.3 above) provide an approximate breakdown between:

3.1 Persons (FTE) involved in projects/programs largely supported by NSERC grants	_____	_____
3.2 Persons (FTE) involved in projects/programs largely supported from sources other than NSERC grants	_____	_____

SECTION C

This section requests information on the number (FTE), costs and type of personnel your service unit NEEDS to provide infrastructure support for ALL research in the natural sciences and engineering in your university.

4.1 Total infrastructure support (present staff plus additional staff) NEEDED for ALL research in the natural sciences and engineering

	No.(FTE)	Costs $
	_____	_____

If the number of staff (FTE) NEEDED in question 4.1 is larger than the figure given in question 2.1 of Section B (the total infrastructure support staff (FTE) presently providing infrastructure support services for research) indicate with the appropriate number (FTE) the ADDITIONAL personnel required for:

5.1 Operation and maintenance of specialized equipment and computer software _____

5.2 Skilled technical and professional services not associated with specialized equipment _____

5.3 Research service facilities including advisory services _____

5.4 Other (specify) _____

You may wish to include comments in SECTION F on possible sources of funding and trends in regard to the additional personnel required to provide infrastructure support for research.

SECTION D

In order to illustrate recent trends in your service unit, give the number of support staff (FTE) working in an infrastructure capacity for ALL research in the natural sciences and engineering in your university for the past two fiscal years.

		No. FTE	Costs $
6.1	Total Infrastructure staff (FTE) supporting research in 1982-83	_____	_____
	Of the total in 6.1 indicate these persons:		
6.2	Paid from NSERC grants	_____	_____
6.3	Paid from university funds	_____	_____
6.4	Paid from other sources	_____	_____
7.1	Total Infrastructure staff (FTE) supporting research in 1981-82	_____	_____
	Of the total in 7.1 indicate those persons:		
7.2	Paid from NSERC funds	_____	_____
7.3	Paid from university funds	_____	_____
7.4	Paid from other sources	_____	_____

SECTION E

This section requests information on non-salary infrastructure costs and needs for the research support activities of your service unit for science and engineering. These costs include the cost of replacement parts, upgrading and service contracts for equipment, etc.

Approximate non-salary infrastructure costs in fiscal year 1983-84 and source of funding.

	Source of funds: NSERC $	University $	Other $
8.1 Replacement parts and minor upgrading for equipment	_____	_____	_____
8.2 Service contracts	_____	_____	_____
8.3 Other non-salary infrastructure costs (explain in SECTION F)	_____	_____	_____

You may wish to comment in SECTION F on recent trends in funding from these sources.

Estimate ADDITIONAL yearly non-salary infrastructure expenditures NEEDED for research support activities of your service unit for the natural sciences and engineering.

	$
9.1 Replacement parts and minor upgrading for equipment	_____
9.2 Service contracts	_____
9.3 Other non-salary infrastructure costs (explain in SECTION F)	_____

You may wish to comment in SECTION F on possible sources of funding for these costs.

SECTION F

The Task Force would appreciate your comments on the overall infrastructure funding issue. We would especially appreciate your comments in relation to Sections C and E.

Natural Sciences and Engineering Research Council of Canada
Conseil de recherches en sciences naturelles et en génie du Canada

Ottawa, Canada
K1A 0R6

President
Président

Appendix B

File Référence

February 15, 1984

In preparation for its second Five-Year Plan, the Natural Sciences and Engineering Research Council has established a Task Force to provide Council with plans and recommendations for the funding of research infrastructure. Briefly, research infrastructure expenses include the costs of maintenance and operation of specialized equipment and the provision of technical support services for research. The membership and terms of reference of the Task Force on Research Infrastructure are enclosed for your information.

In order to fulfill its mandate, the Task Force has to estimate the aggregate research infrastructure needs of Canadian universities in the natural sciences and engineering and the extent to which these needs are not being met by current funding sources. Thus, at the first meeting of the Task Force on February 1, 1984, a decision was taken to seek, by means of a questionnaire to be sent to a representative sample of universities, information on the costs of research infrastructure support in fields funded by NSERC. A list of universities selected to receive questionnaires is enclosed for your information.

As your university has been selected to receive these questionnaires, I would be grateful if you would name an Administrative Officer in your institutiton whom we should contact concerning the distribution of this questionnaire. We anticipate that the questionnaire will be ready to send to the appropriate Administrative Officer by mid-March. Because the distinction between infrastructure costs and other costs of research is difficult to describe, considerable interpretation of the questionnaire may be required. In this regard, it is the wish of the Task Force to follow the procedures established by Council's 1980 Task Force on Research Equipment. Part of the success of that study was due to the appointment, by NSERC, of a liaison person on each campus who was able to resolve questions of interpretation quickly.

Canada

8&5
Canada

Dr. A.N. Bourns, Visiting Research Officer, or Mrs. C. Cudahy, Executive Assistant to the President, will be contacting your office during the week of February 20 to ascertain the name of your designated Administrative Officer and the liaison person of your institution. (These, of course, could be the same individual.) NSERC will provide a small honorarium to the liaison person and will be inviting this person to a briefing session on the questionnaire to be held in Ottawa on March 12, 1984.

May I express my sincere thanks to you for your cooperation with Council on this matter.

Yours sincerely,

G.M. MacNabb

Natural Sciences and Engineering Research Council of Canada
Conseil de recherches en sciences naturelles et en génie du Canada

Ottawa, Canada
K1A 0R6

President
Président

Appendix F

File Référence

February 15, 1984

In preparation its second Five-Year Plan, the Natural Sciences and Engineering arch Council has established a Task Force to provide Council with plans and recommendations for the funding of research infrastructure. Briefly, research infrastructure expenses include the costs of maintenance and operation of specialized equipment and the provision of technical support services for research. The membership and terms of reference of the Task Force on Research Infrastructure are enclosed for your information.

In order to fulfill its mandate, the Task Force has to estimate the aggregate research infrastructure needs of Canadian universities in the natural sciences and engineering and the extent to which these needs are not being met by current funding sources. Thus, at the first meeting of the Task Force on February 1, 1984, a decision was taken to seek, by means of a questionnaire to be sent to a representative sample of universities, information on the costs of research infrastructure support in fields funded by NSERC. A list of universities selected to receive questionnaires is enclosed for your information.

At this time, your university has not been selected as part of the group to be sampled; however, in mid-March you will be receiving a copy of the questionnaire for your information. If, upon reviewing the questionnaire, you feel that your institution would like to complete it or to send NSERC your comments on the subject of research infrastructure funding, your input into this study would be most welcome.

Yours sincerely,

G.M. MacNabb

Canada

Canada

Task Force on Research Infrastructure
Site Visit Schedule

University	Visiting team	Date
U.B.C.	J. Phillips, W.C. Winegard C. Armour	May 28 and 29
U. of Victoria	J. Phillips and C. Armour	May 30
U. of Alberta	M. Morgenstern, L. McArthur	May 23
U. of Saskatchewan	M. Morgenstern, L. McArthur	May 24
U. of Manitoba	W. Winegard, L. McArthur	May 22
McMaster	A. Bourns, L. McArthur	May 29
U. of Toronto	A. Bourns, L. McArthur	May 28
Queens (Statistical consulting science)	W.C. Winegard	May 23
McGill	W. Winegard, C. Armour, A. Bourns	May 25
Ecole Polytechnique	W. Winegard, C. Armour	May 24
U. de Laval	A. Caillé, W. Winegard, S. Shugar	May 2
U. de Sherbrooke	A. Caillé, M. Brochu	May 3
U.N.B.	J.J. MacDonald, W.C. Winegard, L. McArthur	May 17
Dalhousie	J.J. MacDonald, S. Shugar	May 23
T.U.N.S.	J.J. MacDonald, S. Shugar	May 24
Memorial	W.C. Winegard	June 7

Natural Sciences and Engineering Research Council of Canada
Conseil de recherches en sciences naturelles et en génie du Canada

Appendix H

INFRASTRUCTURE GRANTS

Objective

To enable university researchers to operate and use specialized research resources which would not otherwise be viable in Canadian universities and to support the effective use, operation and maintenance of research facilities.

Description

Infrastructure grants support effective use of significant, specialized research resources by providing financial assistance for their operation and maintenance. Such resources would not otherwise be viable in Canadian universities and it would be unreasonable to expect adequate support from user fees, operating grants, and/or other sources. Such resources may be large or special items of equipment, specialized research facilities, or a core of highly skilled technical or professional research support staff essential to the maintenance of the research activities of a number of researchers. Facilities or research resources eligible for support under this program would normally be accessible to research scientists from other departments or institutions. Collaboration with scientists from government and industrial laboratories is encouraged within the program. Infrastructure grants are not intended to assist in the maintenance of facilities standard in a discipline and present in many university departments.

Eligible Items

Infrastructure grant funds may be used for the salaries of technical and professional support staff employed to maintain, develop and operate a facility or to provide infrastructure support to a group of researchers, as well as for other direct costs. They may not be used to support graduate students or postdoctoral fellows or to pay any of the indirect costs of research. Equipment costing less than $7,000 that is essential to the maintenance and operation of the "resource" may be included.

Application Procedures

All applicants must meet the general eligibility conditions outlined in paragraph 11 of the Awards Guide 1983-84.

Applications for infrastructure grants are made by submitting six copies of form 101, Application for Research Grant, accompanied by six copies of the Personal Data (form 100)

Form 139 (1983)

Canada

SUBVENTIONS D'INFRASTRUCTURE

Objectif

Permettre aux chercheurs universitaires de faire fonctionner et d'utiliser des ressources spécialisées qui ne pourraient être viables autrement dans les universités canadiennes, et de maintenir l'utilisation, le fonctionnement et l'entretien efficaces des installations de recherche.

Description

Les subventions d'infrastructure permettent une utilisation efficace de ressources spécialisées en aidant à payer les coûts de fonctionnement et d'entretien. Ces ressources ne pourraient autrement survivre dans les universités canadiennes car on ne pourrait s'attendre à des revenus suffisants en provenance d'autres sources de financement (droits perçus des utilisateurs, subventions individuelles, etc.). De telles ressources peuvent être des appareils spéciaux, des installations de recherche spécialisées, ou encore un groupe de techniciens hautement spécialisés ou de professionnels de la recherche essentiels au maintien des activités de recherche de plusieurs chercheurs. En général, des chercheurs d'autres institutions devraient avoir accès aux installations ou aux ressources qui sont admissibles à ces subventions. Dans le cadre du programme, le Conseil encourage la collaboration avec les laboratoires industriels et gouvernementaux. Les subventions d'infrastructure n'ont pas pour but de venir en aide à des installations propres à une discipline que l'on retrouve dans plusieurs départements universitaires.

Dépenses admissibles

Les subventions d'infrastructure peuvent servir à payer les salaires du personnel technique et professionnel employé pour faire fonctionner, entretenir et améliorer l'installation ou pour fournir l'infrastructure nécessaire à un groupe de chercheurs et payer certains autres frais directs. Ces subventions ne peuvent servir à payer des étudiants diplômés ou des stagiaires postdoctoraux et ne peuvent être utilisées pour couvrir les frais indirects de la recherche. Seuls les appareils de moins de $7 000 qui sont essentiels au fonctionnement et à l'entretien des ressources peuvent être inclus.

Modalités de demande

Tous les candidats doivent satisfaire aux conditions générales d'admissibilité décrites à l'article 11 du Guide des subventions 1983-84.

Pour présenter une demande de subvention d'infrastructure, il suffit de soumettre six exemplaires de la formule 101, Demande de subvention de recherche, dûment remplie. Chaque copie de la formule doit s'accompagner d'une formule de renseignements personnels

Formule 139F (1983)

for each eligible researcher supporting the application. In addition to the pages provided in form 101, two additional pages may be used. Copies of annual reports for the facility (if any) should also be submitted in six copies. The deadline date for submission is November 1.

The application should be followed within three weeks of the deadline date by a letter from the head of the department (or the dean of the faculty if the head of the department is involved in the application, or if the research resource serves more than one department) with the following information:

- the names of the applicants and the titles of the infrastructure grant applications, in order of priority if more than one application is submitted; this may include a description of the mechanisms used in establishing the priorities;
- a brief statement outlining the need for infrastructure support in relationship to the research programs of the eligible users;
- the extent of departmental or university support provided to the facility or resource group.

It is recommended that applicants prepare their application in the following manner:

A: The facility or the resource

Describe the specialized resource (equipment, facilities, specialized research personnel, etc.) and how it compares with other similar facilities or groupings within Canada.

B: The users and the uses

List the users of the facility and provide outlines of the research programs supported by the facility. A brief summary should be given of the major scientific contributions made by users over the past few years. The long-term objectives for the "resource" should be specified, with particular emphasis on projected changes in (i) the nature of the research programs supported, (ii) skills or services provided, (iii) the user community, (iv) the facility itself (e.g. upgrading of equipment). The role of the "resource" as an institutional, regional or national facility should be outlined.

(100) pour chaque membre du groupe admissible aux subventions. Au besoin, on peut ajouter jusqu'à deux pages supplémentaires à celles de la formule 101. Si un rapport annuel est publié par les autorités de l'installation, six exemplaires de ce rapport doivent être soumis. La date limite pour la réception des demandes est le 1er novembre.

Dans les trois semaines suivant la date d'échéance, les demandes devraient être suivies d'une lettre du directeur du département (ou du doyen de la faculté, si le directeur du département ou plusieurs départements participent à la demande) comprenant les renseignements que voici:

- le nom des candidats et les titres des demandes de subvention d'infrastructure, par ordre de priorité s'il y a plus d'une demande; on peut présenter les mécanismes utilisés pour établir les priorités;
- une brève description des besoins de financement d'infrastructure en relation avec les programmes de recherche des utilisateurs admissibles aux subventions du CRSNG;
- l'étendue de l'appui (financier ou autre) fourni au groupe ou à l'installation par le département ou l'université.

Les candidats sont invités à préparer leur demande en tenant compte des points suivants:

A) L'installation ou la ressource

Décrire la ressource spécialisée (appareillage, installations, chercheurs spécialisés, etc.) et la comparer aux autres installations ou groupes semblables au Canada.

B) Les utilisateurs et les utilisations

Donner les noms des utilisateurs de l'installation et un aperçu de leur programme de recherche soutenu par l'installation. Résumer brièvement les contributions scientifiques majeures que les utilisateurs ont réalisées au cours des dernières années. Les objectifs à long terme pour la "ressource" doivent être précisés, en insistant sur les changements prévus dans: i) la nature des programmes de recherche financés, ii) la disponibilité de main-d'oeuvre spécialisée ou technique, iii) l'ensemble des utilisateurs, iv) l'installation elle-même (p. ex. améliorations apportées à l'appareillage). On doit indiquer les fonctions de la ressource en tant qu'installation institutionnelle, régionale ou nationale.

C: Accessibility

If the facility is regional or national in scope, describe:
- how researchers are made aware of the facility;
- the criteria by which "external" users are screened;
- priorities for users (internal vs external; university vs non-university);
- fees charged for various categories of users.

D: Management structure

The role of user committees, management committees, and the facility director or manager should be described.

E: Financial justification

The need for infrastructure support should be justified through a description of why regular sources of funding (e.g. user fees, contributions from operating grants, etc.) are inadequate to ensure a smooth and effective operation of the facility.

Documentation on the current and past use of the facility or resource by internal and external users should be provided.

The research contributions of all persons for whom support is requested should be specified along with an explanation of how their particular skills are essential for the functioning of the technical support group. If the persons were previously supported by other funding sources, an explanation should be provided of why their support should be transferred to an infrastructure grant.

Other components of the financial request should be described in relation to the maintenance and base operation of the research resource. Costs associated with specific experimental projects or programs are not eligible for support through the infrastructure grant; these should be covered through operating, project or strategic grants, etc.

The nature and extent of other forms of support should be described including, if at all possible, a summary of how the research resource was financed in the previous year. For larger facilities it is expected that this information will be contained in the annual report.

C) Accessibilité

Si l'installation est d'envergure régionale ou nationale, décrivez:
- comment les chercheurs sont avisés de la disponibilité de l'installation,
- les critères de sélection des utilisateurs de l'extérieur,
- la priorité accordée aux utilisateurs (internes par rapport à externes, universitaires par rapport à non universitaires),
- les taux imposés aux diverses catégories d'utilisateurs.

D) Structure de la direction

On doit décrire le rôle des comités d'utilisateurs, des comités de gestion et du directeur ou gérant de l'installation.

E) Justification des besoins financiers

Il faut justifier les besoins financiers en infrastructure en donnant les raisons pour lesquelles les sources régulières de subventions (p. ex., honoraires des utilisateurs, contributions des subventions pour dépenses courantes, etc.) sont insuffisantes pour assurer un fonctionnement régulier et efficace de l'installation.

On doit fournir de la documentation sur l'utilisation passée et présente de l'installation ou de la ressource par les utilisateurs internes et externes.

On doit spécifier la contribution au projet de recherche de toutes les personnes pour qui on demande de l'aide financière, en soulignant comment leur expérience est indispensable à l'ensemble du personnel de soutien technique. Si ces personnes recevaient auparavant de l'aide financière en provenance d'autres sources, on doit expliquer pourquoi cette aide doit maintenant être imputée à la subvention d'infrastructure.

Les autres parties du budget doivent être décrites par rapport à l'entretien et au fonctionnement de base de la ressource. On ne peut réclamer à même une subvention d'infrastructure les dépenses relatives à des projets ou programmes expérimentaux précis; celles-ci devraient être obtenues à même les subventions pour dépenses courantes, les subventions pour projet de recherche, les subventions thématiques, etc.

La nature et l'ampleur des autres sources de financement doivent être décrites en comprenant, si possible, celles qui assuraient la viabilité de la ressource au cours de l'année précédente. Dans le cas des installations de grande envergure, on s'attend à ce que ces renseignements soient inclus dans le rapport annuel.

Review Procedures

Infrastructure grant applications are reviewed by one of two mechanisms. Applications involving only one discipline are normally sent to the appropriate grant selection committee. Very large applications and those that are multidisciplinary in nature are reviewed using a mechanism similar to that employed for major equipment and major installation applications, i.e. applications are reviewed by Council's Committee on Grants and Scholarships, on the basis of recommendations from grant selection committees, external referees, selection panels, or, as appropriate, from ad hoc visiting committees.

An annual report is required for all major infrastructure grants.

Selection Criteria

- the extent to which the resource is specialized and significant for the discipline(s) it serves;
- the need for, and effectiveness of, centralized support through an infrastructure grant;
- the research competence of the individuals who will be served by the research resource and the quality of on-going research programs of the users;
- the likely effectiveness of the management and administration of the research resource;
- the nature and extent of the university's commitment and support;
- the accessibility of the resource to users outside the host institution.

Termination Policy

NSERC recognizes that the effective operation of a specialized research facility or resource requires a certain stability of funding to ensure that the best research personnel are retained. It is therefore Council's policy to provide a phase-out mechanism for any infrastructure grant which is terminated after several years of existence. For the smaller infrastructure grants this might entail a one-year terminal grant; for facilities supported at a high level, a one-year grace period, with a strong warning, will be provided prior to any abrupt reduction in support. NSERC funding would then be terminated over a one- to two-year period.

Support of Field Stations

The types of expenditures appropriate for infrastructure support in the case of field stations have been defined by NSERC. The costs of maintaining and operating a field station should be split into two major components; maintenance costs and recoverable costs. Only maintenance costs are eligible for infrastructure support.

Examen des demandes

Les demandes de subvention d'infrastructure sont habituellement évaluées suivant l'un ou l'autre des processus suivants. Les demandes qui ne comportent qu'une discipline sont acheminées vers le comité de sélection approprié. Les demandes interdisciplinaires et les demandes de subventions très considérables sont étudiées selon un processus analogue à celui qui s'applique aux appareils spéciaux et aux installations spéciales: elles sont étudiées par le Comité des subventions et bourses à partir des recommandations transmises par les comités de sélection des subventions, par des examinateurs de l'extérieur, par des comités thématiques ou, s'il y a lieu, par des comités spéciaux itinérants.

Un rapport annuel doit être présenté pour toutes les grandes subventions d'infrastructure.

Critères de sélection

- le degré de spécialisation de la ressource et son importance pour les disciplines desservies;
- la nécessité et l'efficacité d'une aide financière centralisée, sous forme de subvention d'infrastructure;
- la compétence des chercheurs desservis par les ressources demandées et la qualité de leurs projets de recherche actuels;
- une gestion et une administration efficaces des ressources;
- la nature et l'étendue de l'engagement et de l'appui de l'université;
- l'accessibilité de l'installation à des utilisateurs extérieurs à l'université où elle est installée.

Cessation de la subvention

Le CRSNG reconnaît que le fonctionnement efficace d'une installation de recherche spécialisée dépend d'une certaine constance des sources de financement pour assurer la disponibilité des meilleurs chercheurs. Par conséquent, le CRSNG, fidèle à sa politique, a mis en oeuvre des mécanismes de cessation progressive pour les subventions d'infrastructure qui sont terminées après plusieurs années. On pourrait octroyer une subvention terminale d'un an pour les subventions d'infrastructure moins élevées. Par contre, avant de réduire soudainement l'aide financière aux installations qui reçoivent des subventions élevées, le Conseil leur accordera une année de délai et leur servira un sévère avertissement. L'aide financière leur serait alors retirée au cours d'une période d'une ou deux années.

Stations de recherche

En ce qui a rapport aux stations de recherche, le CRSNG a déterminé le genre de dépenses qui peuvent être réclamées à même une subvention d'infrastructure. Les coûts de fonctionnement et d'entretien d'une station de recherche doivent être divisés en deux composantes: les coûts d'entretien et les coûts recouvrables. Seuls les coûts d'entretien peuvent être réclamés à même une subvention d'infrastructure.

(1) The Maintenance

Maintenance costs are those necessary to keep the station in a state of "readiness" for scientific use, no matter how many scientists actually use the facility. This would be the baseline cost of keeping the operation viable, for example over the winter and summer months, and would include salaries and expenses of these persons essential for the functioning of the station but who are not associated with specific research projects.

(2) Recoverable costs

Recoverable costs are those items such as food, gas and salaries of persons employed for specific projects, etc. which should be charged as user fees against individual operating grants or other funding sources, and not included in applications for infrastructure support.

1) L'entretien

On entend par coûts d'entretien ceux qui sont nécessaires pour conserver la station en état de disponibilité immédiate pour utilisation scientifique, quel que soit le nombre de chercheurs l'utilisant réellement. Ceci comprendrait les coûts de base nécessaires à la viabilité de la station, c'est-à-dire pendant l'été et l'hiver, ainsi que les salaires et les dépenses des personnes indispensables à la bonne marche de la station mais qui ne participent pas à des projets de recherche déterminés.

2) Coûts recouvrables

On entend par coûts recouvrables ceux qui peuvent être perçus comme honoraires des utilisateurs (nourriture, essence, salaires des personnes employées pour des projets précis) à même les subventions pour dépenses courantes ou autres sources de financement, et qui ne sont pas inclus dans une demande de subvention d'infrastructure.

Nature of the Infrastructure Type II Facilities Supported

INFRASTRUCTURE II

	1982-1983				1983-1984				1984-1985			
	REQUESTED		AWARDED		REQUESTED		AWARDED		REQUESTED		AWARDED	
	#	000$	#	000$	#	000$	#	000$	#	000$	#	000$
Slowpokes	4	212	4	216	4	223	4	228	5	346	5	236
Field Stations	2	172	1	54	3	239	2	106	4	306	4	174
Marine Facilities	6	1,340	6	872	6	1,467	6	957	8	1,913	7	1,047
Nuclear Reactor	1	529	1	529	1	589	1	575	1	936	1	604
Major New Facilities	3	443	2	230	6	1,422	6	1,051	9	2,212	7 2	1,190 pending
Concurrent with major eq. & inst.	9	581	4	165	7	471	4	142	15	725	4 8	135 pending
Others	1	108	1	31	5	467	4	160	6	591	6	282

includes competition and installments

Distribution of Infrastructure Support by Discipline Committee

INFRASTRUCTURE

COMMITTEE	1982-1983				1983-1984				1984-1985			
	REQUESTED		AWARDED		REQUESTED		AWARDED		REQUESTED		AWARDED	
	#	000$	#	000$	#	000$	#	000$	#	000$	#	000$
1 Animal Bio.	2	92	1	22	4	198	2	61	4	240	3	103
2 Cell Biology	8	185	4	92	5	187	4	98	8	299	5	117
3 Plant Bio.	3	93	3	60	2	60	-	-	1	24	-	-
4 Chem & Met Eng.	4	189	2	40	10	477	7	218	16	870	13	508
5 Chemistry	8	257	6	174	11	441	9	238	20	739	16	435
6 Civil Eng.	7	225	7	188	8	319	7	255	14	844	11	467
7 Computing & Info.	6	331	4	209	11	907	9	540	14	1,062	12	710
10 Earth Sci.	3	98	1	34	8	340	6	207	14	767	12	479
11 Elec. Eng.	6	242	6	94	9	460	6	98	13	635	11	251
12 Psychology	1	68	1	72	3	296	1	76	2	123	2	120
13 Mech. Eng.	7	193	3	48	4	133	2	37	5	217	4	93
14 Statistics	4	112	3	46	5	138	4	83	6	191	6	155
15 Physics	4	184	-	-	12	749	5	232	14	864	7	303
16 Mathematics	-	-	-	-	-	-	-	-	1	25	1	25
17 Space and Astrology	9	551	9	477	10	632	9	521	12	827	9	602
18 Population Biology	3	148	2	44	5	222	4	113	11	422	8	191
20 Ind. Eng.	-	-	-	-	1	34	1	20	3	116	3	72
21 Interdisc.	3	191	2	114	1	27	1	18	5	224	3	64
22 Nuclear Sci.	9	4,956	9	3,963	11	5,214	10	4,186	9	4,902	9	4,025
23 High Energy Physics	-	-	-	-	-	-	-	-	-	-	-	-
27 Int. Energy Physics	2	192	2	99	-	-	-	-	-	-	-	-
29 Grants and Scholarships	28	3,530	20	2,156	34	4,879	29	3,222	50	7,112	34	3,747
											10	pending
TOTAL	117	11,836	85	7,952	154	15,713	116	10,223	210	19,116	166	12,275

Includes competition and instalments

.../2

Appendix J

NOTES CONCERNING DISTRIBUTION MECHANISMS FOR AN EXPANDED RESEARCH INFRASTRUCTURE PROGRAM

In identifying possible mechanisms for an expanded program of research infrastructure support, which would include facilities and services which are standard in a discipline, the assumption is made that the present program of supporting, through application and peer review, infrastructure grants for major "facilities" of a specialized nature will continue. The questions then are whether or not the expanded program should involve applications or should be based on a formula related to levels of NSERC research funding and, if it is the latter, whether or not the distribution should be at the university level, the departmental level, or a combination of the two.

Formula Versus Application

A formula would be simple and involve little NSERC administration.

A formula would require more monitoring on the part of NSERC.

Applications would be consistent with the present selection process and criteria based on excellence.

Applications would increase the amount of paperwork for researchers, NSERC and the universities.

Applications and their peer review would greatly increase the workload for an already overloaded peer review system.

Applications, by adding to the multiplicity of NSERC's application programs, would add to the confusion of researchers concerning what expenditure items are eligible under one program or under another.

What would the evaluation of applications be based on?

a) Peer review (based on excellence) of researchers already reviewed in the operating grant system?

b) Relative needs of departments? Can committees judge this factor? Given the amount of information presently in an application, how much additional information would be required?

Applications would probably disadvantage small groups and small universities.

A Infrastructure Funding (Other than for Specialized Facilities) Given to Departments by Formula

Advantages

1. Closer correlation with excellence according to normal NSERC procedures.

2. Researchers see more directly a return on what they have earned. Provides an incentive to increase operating grants.

3. Decisions on the use of infrastructure funds made closer to the grassroots, hence greater acceptability to researchers.

4. May be less visible to Provincial Governments than funding at the university level.

5. Most common equipment and services are at the department level and a departmental allocation would provide a further incentive for departmental efficiency.

Disadvantages

1. Infrastructure funding needs in relation to total operating grants vary from discipline to discipline and, within a discipline, from university to university. A single proportionality factor could cause serious funding distortions. On the other hand, assigning a different factor for each department would be the equivalent of reviewing individual applications.

2. Services which are provided at the departmental level at some universities are centralized at others. Distribution of infrastructure funding to departments only would create problems for the latter institutions.

3. The maldistribution of infrastructure support by discipline in universities is likely to be perpetuated. For example, a chemistry department having strong university-funded infrastructure support might receive several fold more NSERC-funded infrastructure support than a chemical enginering department that now has very few university funded technical personnel.

4. The university has no opportunity to use the new infrastructure funding to support new initiatives or to redress historically-based inequities.

5. Certain departments might receive a very large infrastructure grant in relation to "additional" needs which could distort university priorities.

6. Small departments might not "earn" enough to support even one technician - again, a factor related to lack of institutional flexibility in the use of funds.

7. Somewhat more administration for NSERC than a distribution at the university level.

8. In some departments, researchers appear to have less confidence in allocation decisions made by a chairman than by a university research board.

B Infrastructure Funding (Other than for Specialized Facilities) Given to the University by Formula

Advantages

1. Provides flexibility for universities to
   a) correct present inequities in the distribution of infrastructure support by discipline;
   b) support new initiatives;
   c) fund central services;
   d) support small departments.

2. Facilitates the formation of high-quality interdepartmental research service facilities.

3. Places the onus on the university, as distinct from departments, to ensure expenditures conform to the intent of the infrastructure program. (This could be a disadvantage.) Better accountability to NSERC.

4. Very little administration by NSERC. Monitoring of program would be easier.

Disadvantages

1. Deviates from NSERC's policy of making grants to researchers rather than institutions.

2. Allocation decisions would not be made at grassroots. (This disadvantage might be ameliorated if NSERC guidelines were to direct universities to distribute the major portion of the block grants to departments in relation to their overall need and level of research activity.)

3. A disporportionate portion of the grant might be spent on central services.

4. NSERC's priorities could be distorted unless guidelines are clear and monitoring of expenditures thorough.

5. Many researchers lack confidence in central university mechanisms for allocation of research funds.

6. More visible to Provinces than small grants to departments and might raise questions in relation to federal-provincial cost sharing.

7. Because the block grants to universities would be relatively large (several millions of dollars in the large universities), questions relating to accountability would loom important.

8. Would present greater temptation to switch personnel from university to NSERC support.

C Infrastructure Funding (Other than for Specialized Facilities) Allocated at Both University and Departmental Levels

Advantages

Many of the advantages of each of the previously described alternatives would be retained. The universities would have sufficient infrastructure funding to support new initiatives, redress historical inequities, support central services, etc. At the same time, substantial funding would go directly to departments in relation to what their members "earn". No department would likely be overfunded, while universities would be in a position to provide supplementary funding to departments which might be seriously underfunded in any strictly departmental NSERC allocation.

Disadvantages

1. More administrative work for NSERC.

2. Would require accountability at two levels.

A 50:50 university-departmental split of infrastructure funding (other than that applied to specialized facilities) might provide the best assurance that the advantages of both the departmental and the university allocation mechanisms are realized. At the same time, their disadvantages would be minimized. Other ratios, however, warrant consideration.

Appendix K

Minority Report Submitted by Dr. Alain Caillé,
Membre of the Task Force and Member of Council

Note: Although the attached letter may give the impression that its author does not support the main conclusion of the report, i.e. an urgent need for infrastructure support in Canadian universities, the author stated in a telephone conversation that he is convinced of the need for infrastructure and that he supports the principle of NSERC infrastructure grants. As pointed out in the letter, however, he believes that the mechanisms proposed in the report should be given more consideration.

Telephone conversation between A. Caillé and Mireille Brochu, Secretary of Council, 28 September 1984.

September 6, 1984

Mr. Gordon M. MacNabb
President
Natural Sciences and Engineering
Research Council of Canada
200 Kent Street
Ottawa, Ontario
K1A 1H5

Dear Mr. MacNabb:

As a member of the Task Force on Infrastructure, I am unable to endorse the final report of our committee. I have so informed Dr. Arthur Bourns and I have made known to him my points of disagreement. I ask you to consider this letter as my minority report. My discussion will be brief for lack of time and for lack of the means necessary to elaborate in detail each of the points brought forward.

First, I do not believe that the problem of funding of infrastructure costs is the most important one nor is it the major impediment to the consolidation and the development of quality and excellence in research in Canadian universities. In my opinion, the difficulty of integrating young researchers into permanent positions, with all the dynamism that this represents, constitutes the primary obstacle to excellence in university research in Canada. Resulting from this difficulty, it will be hard for us in Canada to pursue new research opportunities (particularly in fundamental research) which arise constantly in this activity which is delineated and defined at the international level. It is only with the influx of young researchers and new ideas that we will also be able to create areas for graduate training which will spawn an inventive and innovative spirit. Financial support for infrastructure costs can only ensure that there is a good volume of activities, but cannot ensure the excellence and high quality of these activities.

As for the proposal to reduce the number of equipment grants in favour of infrastructure grants, I must also register my disagreement. NSERC equipment grants are quite often the only source of funds available to a young experimental scientist to start up his laboratory and to pursue

... /2

the free experimental research that is dear to him and that is central to his research activities. For this latter reason, it is essential that we maintain (and strengthen if possible) this program.

Finally, I must also express my disagreement concerning the formula developed for the financing of infrastructure. My comments deal essentially with the technical aspects, leaving aside the political aspects where one could say a lot. In fact, the formula by which we would award an infrastructure grant is calculated on the basis of a percentage of the grants already awarded through other programs; this seems to me to add a further element of distortion to the system.

The rich become richer and the poor, poorer. And yet, one would admit a priori that the intrinsic potential for scientific development is the same in all regions of Canada. A simple criterion of cost effectiveness incites us to favour an equitable devlopment among the different regions in order to profit from this intrinsic scientific potential in an optimal fashion. Moreover, it is in the definition of the Council's responsibilities to promote scientific development and research manpower training. NSERC is perhaps not responsible for these disparities, but it should not, through its programs, accentuate these disparities.

I hope to have to opportunity to discuss with you the different points mentioned in this letter at the meeting in Ottawa on September 13.

Yours sincerely,

Alain Caillé